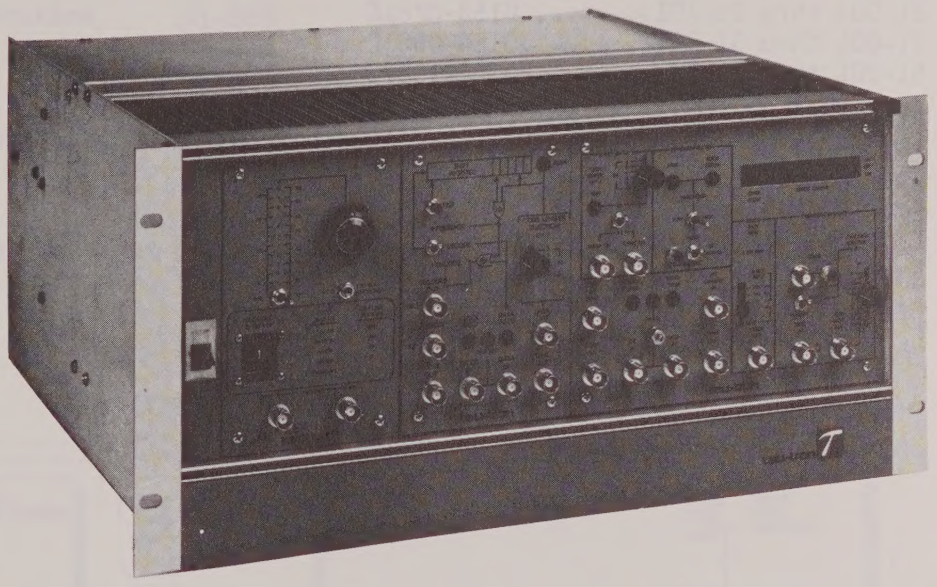
ME-7927
February 1983

tau-tron
A UNIT OF GENERAL SIGNAL



CONFIGURATION

Details of your instrument's serial numbers and configurations are contained in the individual manuals. Basic configration is as follows:

Units:

MF-2 Mainframe
MS-101 Clock Source
MN-1 Pseudorandom Data Generator
MB-1A BERT Receiver

Options:

___ None.
___ OP-01 Special Input/Output Characteristics
___ OP-04 Crystal-Controlled Clock Frequency
___ OP-07 Extened Resolution

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BERTS-75

BIT ERROR RATE TEST SET

TECHNICAL MANUAL

ME-7927

form 0151-1081C

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(617) 256-9013 Telex 951952

LIST OF EFFECTIVE PAGES

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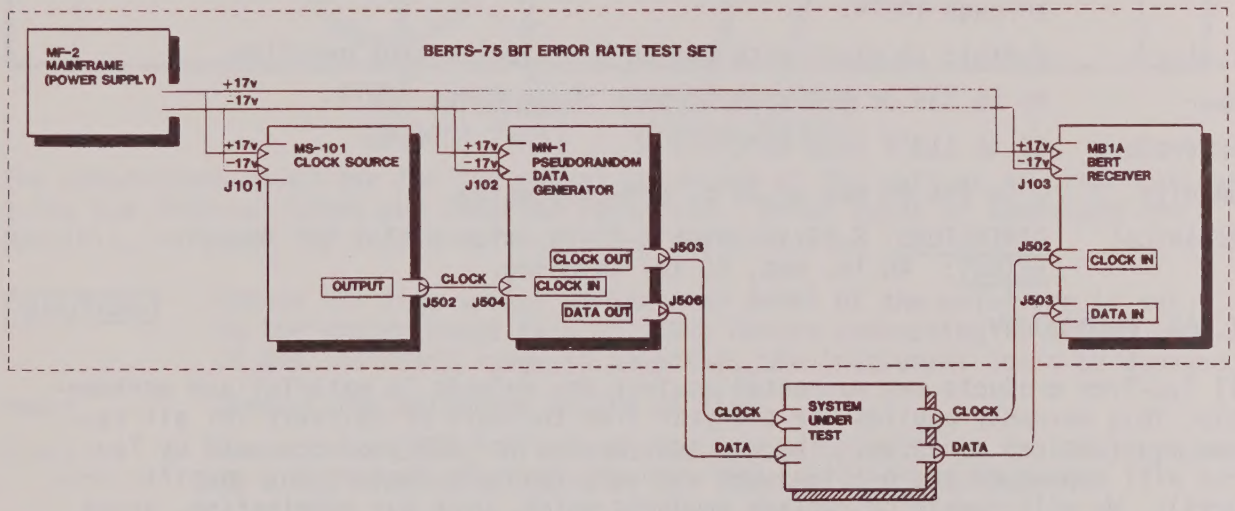
01.001 **SCOPE**

This instruction manual provides operation and maintenance information for the Tau-Tron BERTS-75 Bit Error Rate Test Set.

01.002 **DESCRIPTION**



The Tau-Tron BERTS-75 is a modular instrument for bit error-rate measurements up to 75MHz. It generates pseudorandom bit patterns for stimulating the system under test and measures the bit-by-bit errors on the patterns as they are received from the system under test. Total bit errors, total block errors, bit error rate, block error rate, bit errors per frame, and block errors per frame can be measured.

The set consists of an MF-2 Mainframe, an MS-101 Clock Source, an MN-1 Pseudorandom Data Generator, and an MB-1A BERT Receiver.

01.003 **GENERAL SPECIFICATIONS**

Detailed specifications are given for each unit in their respective sections.

Clock Out	1kHz to 75MHz continuously variable, 2V into 50Ω to ground. to system under test.
Data Out	1Hz to 75MHz continuously variable, NRZ format, 2V into 50Ω to ground, to system under test.
Clock In	1b/s to 75 Mb/s, 2V into 50Ω to ground, from system under test.
Data In	1b/s to 75Mb/s, NRZ format, 2V into 50Ω to ground, from system under test.

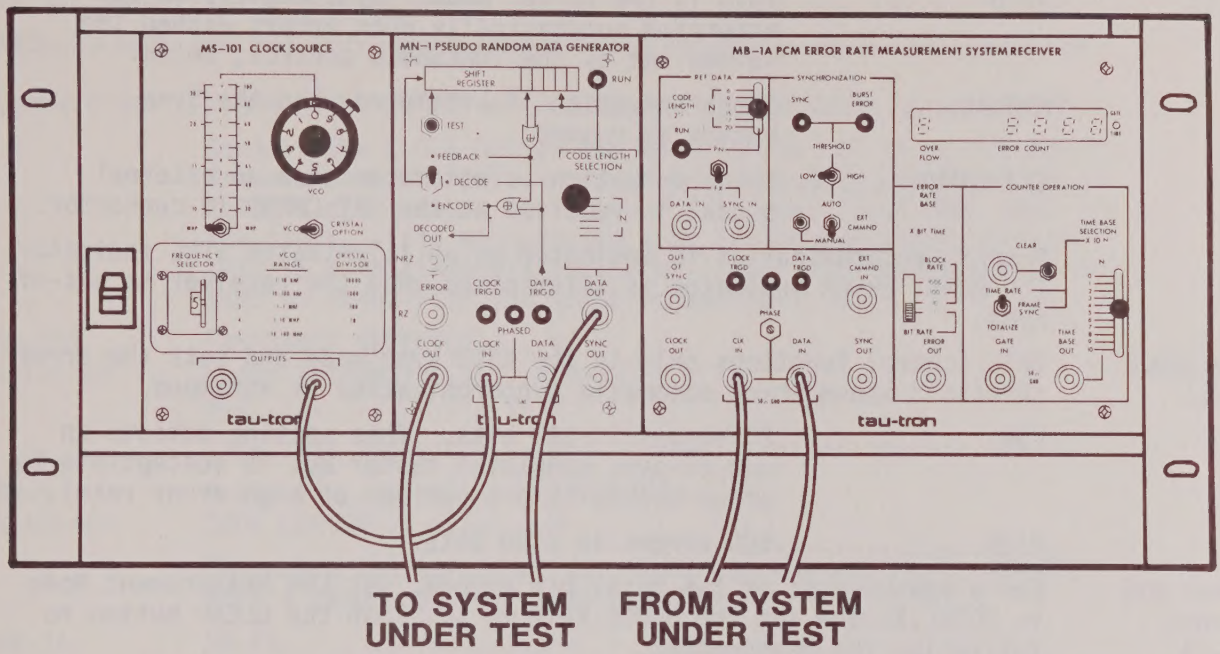
Data Patterns	Pseudorandom with choice of 6 front-panel selected lengths of 2^6-1 (63), 2^9-1 (511), 2^{11}-1 (2047), 2^{15}-1 (32,767), 2^{17}-1 (131,071), or 2^{20}-1 (1,048,576) bits.
Synchronization	Three modes are available as selected by a front-panel control: AUTOMATIC: Sync acquired automatically when error rate exceeds 20%. MANUAL: Sync triggered by a front-panel pushbutton. EXTERNAL: Sync triggered by an external signal.
Measurements	Six modes are available as selected by front-panel controls: TOTAL BIT ERRORS: Bit errors accumulated indefinitely. TOTAL BLOCK ERRORS: Error-blocks accumulated indefinitely, with block lengths of 10,100, or 1000 bits as set by a front-panel control. BIT ERROR RATE: Bit error rate measured, with range selection of 10^{-1} through 10^{-10}. BLOCK ERROR RATE: Errored blocks measured, with range selection of 10^{-1} through 10^{-10}. BIT ERRORS PER FRAME: Bit errors per total frames measured, with range selection of 10^{0} through 10^{-10}. BLOCK ERRORS PER FRAME: Errored blocks per total frames measured, with range selection of 10^{0} through 10^{-10}.
Display	4-digit (6 digit with Option 07) display plus overflow.
Power	90 to 135 or 180 to 270V 10%, 50 to 60Hz, 220VA.
Temperature	32 to 113°F (0to 45°C).
Humidity	0 to 95% RH max at 20°C, non-condensing.
Mechanical	DIMENSIONS: 8.75 in. high X 19 in. wide X 17.1 in. deep. WEIGHT: 40 lb. net, 50 lb. shipping.

01.004 **WARRANTY**

All Tau-Tron products are warranted against any defects in material and workmanship. This warranty applies for one year from the date of delivery for all Tau-Tron manufactured products. The warranty period for OEM products sold by Tau-Tron will depend on the original OEM warranty (consult factory for specific products). We will repair or replace products which, upon our examination, prove to be defective during the warranty period.

NO OTHER WARRANTY, EXPRESSED OR IMPLIED. INCLUDING FITNESS FOR PURPOSE, MERCHANTABILITY OR OTHERWISE, IS GIVEN.

01.005 **CONNECTIONS**



The connections given are for the normal operation of the unit as an error test set using the internal clock and internal reference. Other types of operation are possible, refer to the sections for the individual units.

CAUTION Ensure the line switch on the rear panel of the mainframe is set to the proper range (115 or 230V) before connecting to the ac line. If the incorrect range is selected, the instrument could be damaged.

Power — Connect the mainframe to the ac line.

Clock — Connect the OUTPUT of the MS-101 to the CLOCK IN of the MN-1 by means of a BNC terminated cable of the shortest practical length.

System Under Test — Connect the CLOCK OUT and the DATA OUT of the MN-1 to the system under test. Connect the clock and data outputs from the system under test to the CLK IN and DATA IN connectors of the MB-1A.

01.006 **SETTINGS**

These control settings are for the normal operation of the unit as an error test set using the internal clock and internal reference. Other types of operation are possible, refer to the sections for the individual units.

Frequency MS-101 — Set the FREQUENCY SELECTOR, Scale Selector, and VCO control for the desired frequency.

Pseudorandom Pattern MN-1 — Set the MODE to FEEDBACK and the CODE LENGTH to the desired pattern length.

Phasing MB-1A — Set the front-panel screwdriver PHASE adjustment for the proper clock/data phasing as indicated by an illuminated PHASE indicator (see Paragraph 61.202 for details).

Internal Pattern — Set the PN-FX control to PN and set the CODE LENGTH control to the same pseudorandom pattern length as that set on the MN-1 above.

Sync MB-1A	Set the Sync Mode control to the desired sync mode: AUTO.....This is the normal mode. Synchronization is attempted automatically when errors exceed the values set by the THRESHOLD control, below. MANUAL.....Synchronization is attempted when the Sync button is pushed. EXT CMMND.....Synchronization is attempted when an external signal is received at the EXT CMMND IN connector. Proper synchronization is indicated by an illuminated SYNC indicator. The BURST ERROR indicator is illuminated when the receiver is out-of sync.
THRESHOLD MB-1A	This control functions only in the AUTO sync mode and sets the error threshold above which automatic synchronization is attemped. LOW.....20 errors in 100 bits. This setting detects an out-of-sync condition faster but is susceptible to error bursts (short periods of high error rate). HIGH.....500 errors in 2500 bits.
Total Bit Errors MB-1A	For a measurement of the total bit errors, set the Measurement Mode to TOTALIZE and set the BLOCK RATE to 1. Push the CLEAR button to initialize the measurement.
Total Block Errors MB-1A	For a measurement of the total block errors, set the Measurement Mode to TOTALIZE and the BLOCK RATE to 10,100, or 1000 bits, as required for the desired block length. Push the CLEAR button to initialize the measurement.
Bit Error Rate MB-1A	For a measurement of the bit errors per total bits, set the measurement Mode to TIME RATE and set the BLOCK RATE to 1. Set the TIME BASE for the desired resulution*.
Block Error Rate MB-1A	For a measurement of the errored blocks per total blocks, set the Measurement Mode to TIME RATE and set the BLOCK RATE to 10,100, or 1000 bits as required for the desired block length. Set the TIME BASE for the desired resolution*.
Bit Errors Per Frame MB-1A	For a measurement of the bit errors per total frames, set the Measurement Mode to TIME RATE and set the BLOCK RATE to 1. Set the TIME BASE for the desired resolution*.
Block Errors Per Frame MB-1A	For a measurement of the errors blocks per total frames, set the Measurement Mode to TIME RATE and set the BLOCK RATE to 10,100, or 1000 bits as required for the desired block length. Set the TIME BASE for the desired resolution*.
*TIME BASE	For maximum resolution the TIME BASE normally should be set for the maximum displayed count without overflow. For low clock rates, however, this would result in very long measurement times (days or weeks) and therefore be impractical so that shorter TIME BASE lengths must be used.

01.007 **BACK-TO-BACK TESTING**

Back-to-back testing provides a simple check of the overall set operation.

Connections

Connect the OUTPUT of the MS-101 to the CLOCK IN of the MN-1.

Connect the CLOCK OUT of the MN-1 to the CLK IN of the MB-1A. Connect the DATA OUT of the MN-1 to the DATA IN of the MB-1A using a cable about 40 inches (5ns) longer than that used for the clock. This will ensure that the proper phase relationship is maintained within the MB-1A for all frequencies from 1KHz to 75MHz with the PHASE adjust fully ccw.

MS-101 Settings

FREQUENCY SELECTOR.....4
Scale Selector.....10-30
VCO.....0

This sets the clock output to 1MHz.

MN-1 Settings

Mode.....FEEDBACK
CODE LENGTH.....6

This sets the generator for a pseudorandom pattern output with a length of 2^6-1 (63) bits.

MB-1A Settings

PN-FX.....PN
CODE LENGTH.....6
Sync Mode.....MANUAL
BLOCK RATE.....1
THRESHOLD.....LOW
Measurement Mode.....FRAME
TIME BASE.....0

This sets the receiver to measure bit errors per frame, integrated over one frame, manual sync.

Manual Sync

Push the SYNC button to synchronize the receiver and push the CLEAR button to initialize the measurement. The SYNC indicator should light and the ERROR COUNT display should read zero.

TEST

Push the TEST button on the MN-1. The BURST ERROR indicator on the MB-1A should light. Push the Sync button on the MB-1A. The SYNC indicator should light.

Auto Sync

Change the sync Mode to AUTO on the MB-1A and push the TEST button on the MN-1. The BURST ERROR indicator on the MB-1A should light. Release the TEST button. The SYNC indicator on the MB-1A should light.

50% bit errors N=0

Disconnect the cable from the MB-1A DATA IN connector and change the Sync Mode to MANUAL. Since the data input is now open circuited, the receiver considers the logical 1's of the selected sequence to be in error by approximately 50%.

Push the CLEAR button to initialize the measurement and push the Sync button to synchronize the receiver. The SYNC indicator light should light and the ERROR COUNT display should read 32.

Change the CODE LENGTH controls on the MN-1 and MB-1A as follows and note the display:

CODE LENGTH	ERROR COUNT Display 4-digit	6-digit
6	32	32
9	256	256
11	1024	1024
15	1 6384	16384
17	1 5536	65536
20	1 4288	524288

50% bit errors N=1

Change the TIME BASE control on the MB-1A to 1. Change the CODE LENGTH controls on the MN-1 and MB-1A as follows and note the display increases by a factor of 10:

CODE LENGTH	ERROR COUNT Display 4-digit	6-digit
6	320	320
9	2560	2560
11	1 0240	10340
15	1 3840	163840
17	1 5360	655360
20	1 2880	1 242880

100% block errors

Change the BLOCK RATE control on the MB-1A to 10 and CODE LENGTH controls on the MN-1 and MB-1A to 6. The system is now measuring errored blocks (of 10 bits each) per 10 frames. Since there is still an approximate 50% bit error rate, all six blocks per frame will be errored so that the display should read approximately 60.

END

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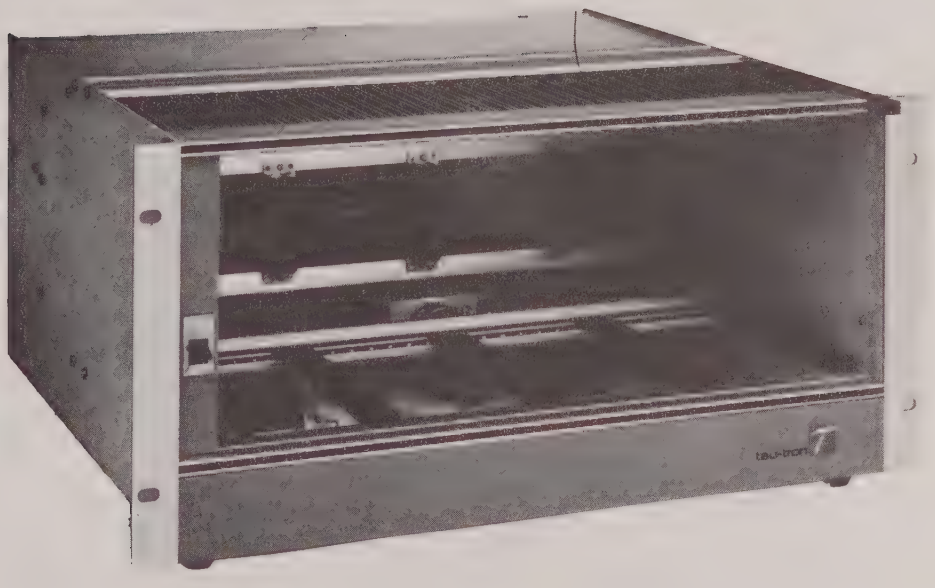
GENERAL SIGNAL



CONFIGURATION

Your unit is **serial number** _____ and is configured as follows (information on these differences is contained in the body of the manual and/or in the rear of the manual under Changes):

Variations:

____VA-01 Hi-current

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MF-2

MAINFRAME

INSTRUCTION MANUAL

form 0152-0581C

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11.106 Claims.....11-102
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11.101 SCOPE

This instruction manual provides operation and maintenance information for the Tau-Tron MF-2 Mainframe, including all serial numbers, options, variations, and modifications.

11.102 DESCRIPTION

The Tau-Tron MF-2 Mainframe provides power, cooling, and mechanical support for TMI (Tau-Tron Modular Instrumentation) plug-in modules.

11.103 SPECIFICATIONS

Modules	The MF-2 accepts up to 4 quarter-size modules, 2 half-size modules, or 1 full-size module and supplies unregulated +34V, +17V -34V, and -17V to all modules via internal wiring. Signal interconnections are by means of connectors on the front-panel of the modules.
Cooling	Two rear-mounted fans exhaust air through the top.
Power	90 to 135V or 180 to 270V ±10%, 50 to 60 Hz ac, via a 6-foot detachable power cord (supplied) that attaches to a rear-panel receptacle.
Mechanical	For rack mounting in a standard 19-in rack; feet are provided for bench top use. DIMENSIONS: 8.75 in. high X 19 in. wide X 17.1 in. deep. WEIGHT: 30 lb net, 40 lb shipping.

11.104 WARRANTY

All Tau-Tron products are warranted against any defects in material and workmanship. This warranty applies for one year from the date of delivery for all Tau-Tron manufactured products. The warranty period for OEM products sold by Tau-Tron will depend on the original OEM warranty (consult factory for specific products). We will repair or replace products which, upon our examination, prove to be defective during the warranty period.

NO OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING FITNESS FOR PURPOSE, MERCHANTABILITY OR OTHERWISE, IS GIVEN.

For any assistance, contact Customer Service with details of the instrument model, serial numbers and malfunction, see Repair Returns.

11.105 SHIPPING DAMAGE

If any signs of damage are noted on the outside of the carton, request the carrier's agent to be present during unpacking. If external damage is found on the instrument follow Repair Returns procedure below.

Check out the electrical performance of the instrument as soon as possible after receipt. If any malfunctions are observed, follow Repair Return procedure below.

11.106 REPAIR RETURNS

For mechanical damage or electrical malfunctions, notify Tau-Tron immediately and if the damage occurred during shipping, also notify the carrier. To return a unit for repair:

1. Call the Customer Service Dept., (617)256-9013, for a Repair Authorization Number. This will reduce administrative delays and ensure prompt return of your unit.
2. Complete and attach the Repair Tag, in the rear of the manual, to your unit for positive identification.
3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb) and shock absorbing material such as bubblewrap to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.
4. Send to: Tau-Tron
   27 Industrial Ave.
   Chelmsford, MA 01824
   Attn: Customer Service

11.107 ASSISTANCE

For service assistance call the Tau-Tron Customer Service Dept., (617)256-9013. Their experience and expertise can often save you valuable time in correcting any equipment malfunction.

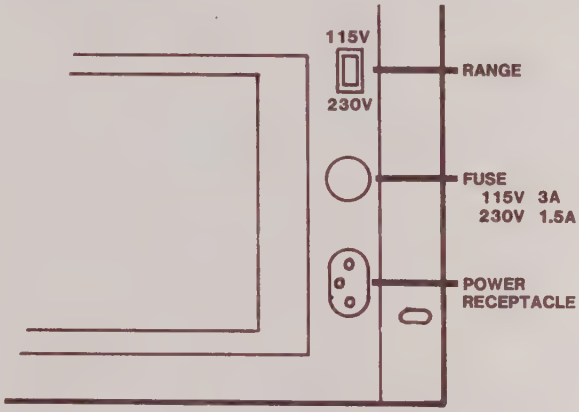
11.108 **POWER**

CAUTION Be sure the line switch on the rear panel is set to the proper range (115 or 230V) before connecting to the ac line. If the incorrect range is selected, the instrument could be damaged.

Range — Use a blade-type screwdriver to set the line switch to the proper range; up for 155V, down for 230V.

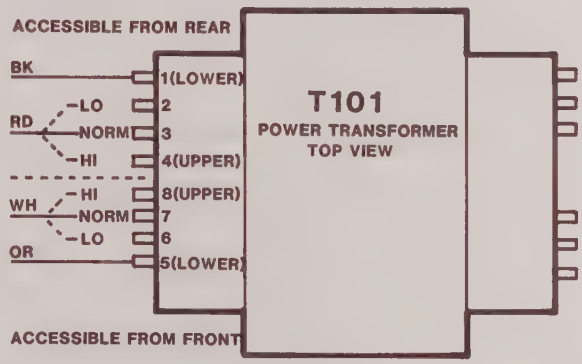
Fuse — For 115V operation the fuse is 3A slo-blo Tau-Tron 9000-0106, for 230V operation the fuse is 1.5A slo-blo Tau-Tron 9000-0101.

Power Cord — A 6-foot 3-wire power cord, supplied, attaches to a rear-panel receptacle.



Compensation — To accomodate variations in line voltages from the normal 115 or 230V ranges, the primary wiring to power transformer can be changed as follows:

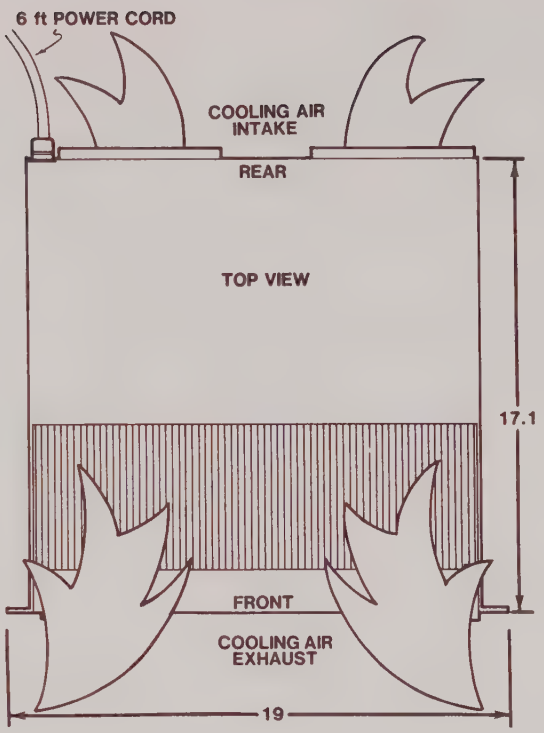
Range	Compensation	RD	WH
115V	Lo:90 to 110V	2	6
	Norm:105 to 125V	3	7
	Hi:115 to 135V	4	8
230V	Lo: 180 to 220V	2	6
	Norm:210 to 250V	3	7
	Hi:230 to 270V	4	8



Access to terminals 6,7,and 8 is from the front after removal of the modules. Access to terminals 1,2,and 3 is from the rear after removal of the rear cover plate. All connections are soldered.

11.109 **SITE REQUIREMENTS**

Power	90 to 135V or 180 to 270V in 6 ranges, 50 to 60 Hz, 220VA, via a 6-foot detachable cord that connects to a rear-panel receptacle.
Temperature	32 to 113°F (0 to 45°C).
Humidity	0 to 95% RH max at 20°C, non-condensing.
Clearances	2 in. min rear, 2 in.min top, to allow cooling air to be drawn in the rear, circulated through the instrument, and exhausted through the top. To ensure proper cooling, all module positions should be filled with functional modules or blank modules.



11.110 **INSTALLATION**

Rackmounting

1. Remove modules, if installed (see below, Module Removal),
2. With a slot-head screwdriver, remove the four rubber feet located on the bottom.
3. Provide mounting channels in the rack for the MF-2 to rest on (the MF-2 requires rear support). Allow 2in. in the rear and 2in. on top for proper cooling.
4. Slide the MF-2 into the rack on the mounting channels and secure the front panel to the rack with screws.

Bench-mounting

1. Place MF-2 on any flat surface capable of supporting 50 lbs.

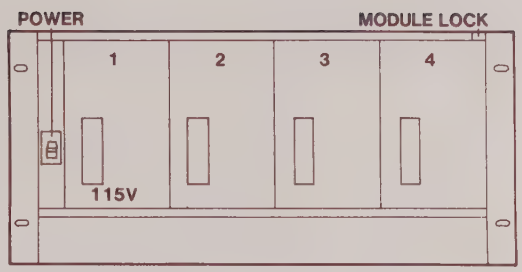
CAUTION Be sure the line switch on the rear panel is set to the proper range (115 or 230V) before connecting to the ac line. If the incorrect range is selected, the instrument could be damaged.

Power — Check that the line switch on the rear panel is set to the proper range (115 or 230V) and then connect the line cord to the rear-panel receptacle and to a source of ac line power.

External Control — Connect external control cable to rear-panel remote programming connector, if installed.

Module Insertion

1. Pull out the Module Lock knob.
2. Insert the functional or blank module(s) as required.



The module(s) can be inserted in any position desired except any user-built module that requires ac **power must connect to the position-1 connector.** In general, systems shipped by Tau-Tron have modules inserted in the following order:

Position 1...Clock
Position 2...Transmitter
Position 3...Receiver

3. Push in the Module Lock knob.

Module Removal

1. Pull out the Module Lock knob.
2. Grasp the module to be removed by its front-panel BNC connector(s) and pull to remove.
3. Push in the Module Lock knob to prevent the remaining modules from accidently falling out.

11.200 **CONTENTS**

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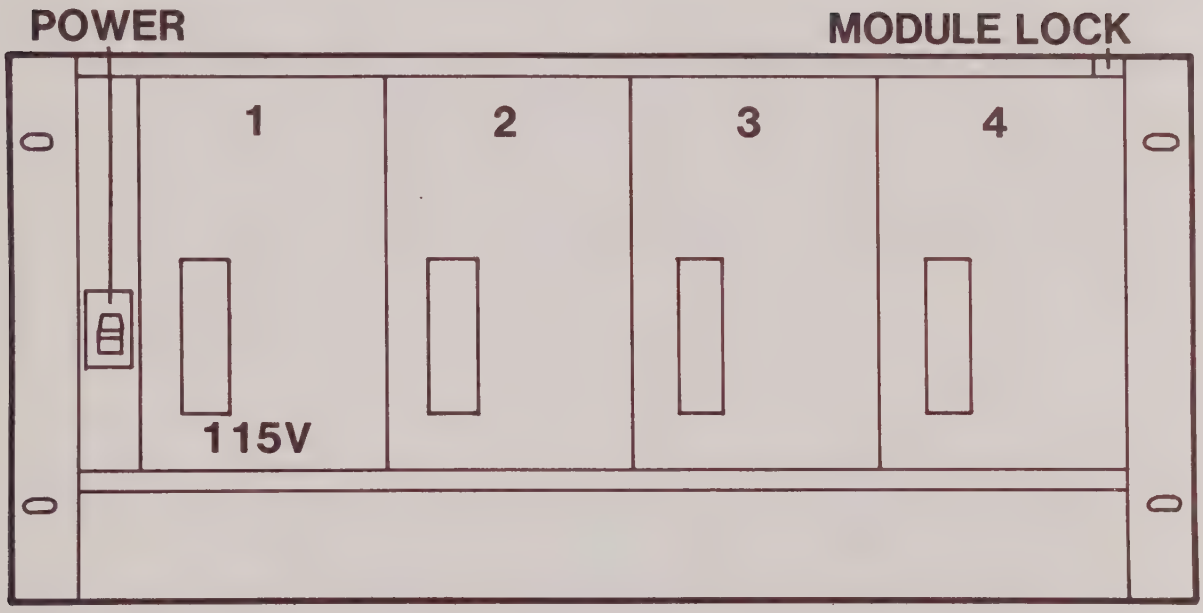
11.201 **FRONT PANEL**



Power — Two-position toggle switch controls power to instrument; off(down) and on(up).

Module Lock — Secures modules in mainframe; lock (in), unlock (out).

11.202 **OPERATION**

Once the system is connected to the ac line and the modules are installed it is ready to operate.

Power On — Set the Power switch up (on); the indicator in the switch should light. Power is now applied to all modules in the mainframe and they should be operational.

System interconnections and module operation are described in the instruction manuals for the individual modules.

Power off — Set the Power switch down (off); the indicator in the switch should extinguish.

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11.301 AC INPUT

Diagram 11A12

The Ac line input is applied via a 6-ft detachable power cord to a rear-panel connector J105. The hot side is fused by F101, controlled by the front-panel Power switch S102, and applied via TB102 and S101 to the two fan motors B101 and B102 and to the primaries of the power transformer T101.

S101 is the rear-panel Range switch and allows 115V operation by connecting the two primary windings in parallel, and 230V operation by connecting them in series. Each primary winding is tapped to allow operation from nominally lo, normal, or hi line voltages.

11.302 DC OUTPUT

Diagram 11A12

The power transformer T101 includes two center-tapped secondary windings, each of which is connected to a full-wave bridge rectifier D101 and D102. D101 supplies two positive voltages of +34V and +17V via current-limiting resistors R101 and R102. Both outputs are filtered, unregulated dc, 6 A max total. D102 is identical to D101 except it supplies two negative voltages, 12 A max total.

The positive voltages are connected via TB103 to each of the module connectors J101 thru J104; the negative voltages are connected to these same connectors via TB104.

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11.401 ROUTINE SERVICE

Air Filters — Periodically clean the two rear-panel filters to maintain proper air flow for adequate cooling:

1. Insert a blade screw driver into one of the notches located at each corner on the side of the filter holder and pry the holder off.
2. Use a vacuum cleaner to clean the filter cover and screen.
3. Reinstall the filter and screen and secure by snapping the cover back on.

11.402 TROUBLE ANALYSIS

WARNING Hazardous voltages exist in this equipment. Do not attempt access to the interior without first disconnecting the line cord from the power receptacle.

No Operation — Failure of the instrument to operate or of the Power switch indicator to light in the on(up) position may be caused by:

1. Lack of ac power to the wall receptacle (check its breaker or measure its voltage).
2. Failure of fuse F101 (replace with a known good fuse, 3A slo-blo for 115V, 1.5A slo-blo for 230V).
3. Range switch on rear-panel is wrong position (up for 115V, down for 230V).

Erratic Operation — Erratic operation of the instrument may be due to failure or partial failure of the dc supplies.

11.403 OUTPUT CHARACTERISTICS

	Minimum DC value of Ripple at low line				
Supply	0A	2A	4A	6A	8A
+34V	30V	25V	22V	19V	16V
+17V	15V	12.5V	11V	9.5V	8V
-34V	30V	25V	22V	19V	16V
-17V	15V	12.5V	11V	9.5V	8V

11.404 **MODULE LOADS**

	.....CURRENT REQUIRED IN A.....					
Module	+34V	+17V	-34V	-17V	Total	
MA-2	...	0.5	...	0.8	1.3	
MA-4	0.4	0.1	0.5	0.5	1.5	
MA-6	3.6		0.2		3.8	
MA-20	0.5	...	0.5	0.005	1.005	
MA-101	0.8	...	...	0.9	1.7	
MA-301						
MA-550	0.8	...	0.8	...	1.6	
MB-1	...	1.9	...	3.4	5.3	
MB-1A	...	1.8	...	4.0	5.8	
MB-301	...	2.0	...	5.0	7.0	
MB-302	...	1.8	...	4.3	6.1	
MBG-1	...	3.9	...	9.2	13.1	VA-01 only
ME-1A	...	2.4	...	2.2	4.6	
ME-301	0.1	0.6	...	1.4	2.1	
ME-302	...	0.2	...	1.5	1.7	
MG-1	...	0.2	...	1.5	1.7	
MG-3	...	2.8	...	4.8	7.6	
MG-15	...	0.6	...	2.5	3.1	
MG-301	...	0.4	...	1.7	2.1	
MG-302	...	0.8	...	3.2	4.0	
MI-1	...	0.4	...	0.2	0.6	
MK-2	...	1.4	...	1.2	2.6	
MK-4	...	1.0	...	9.2	10.2	VA-01 only
MM-1	...	0.3	...	2.5	2.8	
MMX-1	...	1.2	...	2.6	3.8	
MMX-3	...	0.6	...	0.8	1.4	
MN-1	...	0.3	...	1.2	1.5	
MN-301	...	0.2	...	3.0	3.2	
MN-302	...	.8	...	2.8	3.6	
MS-1	...	0.5	...	0.9	1.4	
MS-2	0.3	0.3	...	1.1	1.7	
MS-3	...	0.2	...	0.9	1.1	
MS-101	...	0.2	...	0.7	0.9	
MS-301	0.02	0.4	...	0.9	1.32	
MS-302						
MS-1001	0.4	0.3	...	2.7	3.4	
MW-1	...	0.3	...	1.0	1.3	

11.405 **TEST PROCEDURE**

Equipment

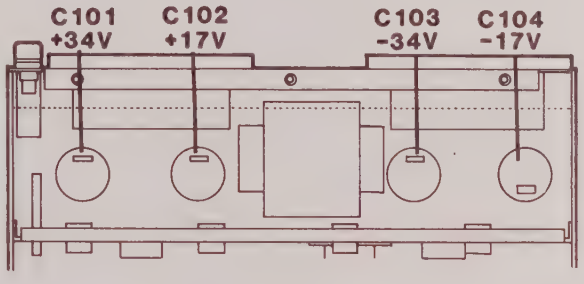
The specifications given are those necessary to perform the tests and are not necessarily those of the suggested equipment.

a. Auto-transformer — Capable of varying ac line -10%, 300W, with output ac voltmeter. Variac W5WMT3VM (115V line) or Variac W5HMT with seperate voltmeter (230V line).

b. Oscilloscope — 1 to 5 V/div sensitivity. Tektronix 475.

Procedure

1. Initial setup — Remove the top cover and baffle. Insert a full complement of modules and connect the MF-2 to a variable ac line.



WARNING Hazardous voltages exist in this equipment. Stay clear of all line-voltage wiring and terminals.

2. Pilot lamp, fans — Turn on power. Indicator lamp in power switch must light and both fans must turn at maximum rpm.

3. Outputs — Set the line voltage to the low end (90,105,115,180,210, or 230V). Connect the dc-coupled input of the oscilloscope to each of the four output voltages. Ripple must be twice line frequency (100 or 120Hz) and dc voltage must not fall below minimum given:

Supply	Test Point	Ripple Minimum DC Level
+34V	C101	27V
+17V	C102	10V
-34V	C103	27V
-17V	C104	10V

11.500 **CONTENTS**

11.501 Replaceable Parts..... page 11-501

11.501 **REPLACEABLE PARTS**

Reference designations include unit and assembly prefixes.

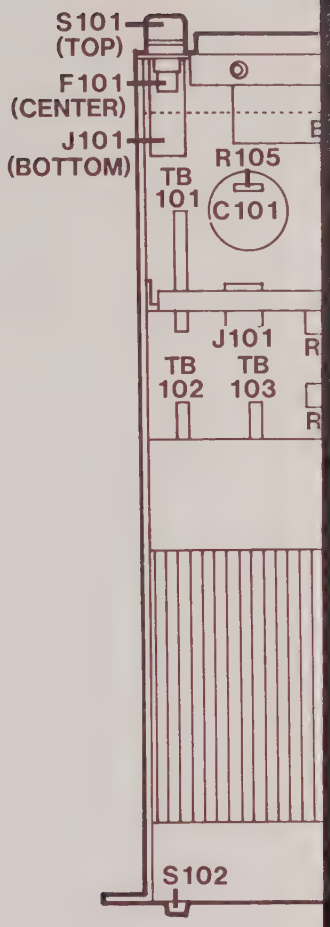
Ref Des	Description	Tau-Tron No.
11A11	**FRAME**	
11A11	Module guides;.....	9350-1001
11A11	Module guide spacer strip;.....	9350-1006
11A11	Identification strip;.....	9350-1007
11A11	Mounting-ear pair;.....	9350-1008
11A11	Vinyl feet;.....	
11A11 J101 thru 11A11 J104	Connector, 24-pin;.....	9300-0104
11A12	**SUPPLY**	
11A12 B101	Fan; Rotron WRZH1.....	9000-0302
	Uses two mounting brackets.....	9705-3068
11A12 B102	Fan; Rotron WRZH1.....	9000-0302
	Uses two mounting brackets.....	9705-3068
11A12 C101	Capacitor, 4200μF 50V electrolytic.....	1034-6452
	Uses clamp;.....	9160-0000
11A12 C102	Capacitor, 4200μF 25V electrolytic.....	1034-6452
	Uses clamp;.....	9160-0000
11A12 C103	Capacitor, 4200μF 25V electrolytic.....	1034-6452
	Uses clamp;.....	9160-0000
11A12 C104	Capacitor, 8200μF 25V electrolytic.....	1034-4482
	Uses clamp;.....	9160-0000
11A12 C105	VA-01 only: Capacitor, 8200μF 25V electrolytic.....	1034-4482
	Uses clamp;.....	9160-0000
11A12 D101	Rectifier, bridge;.....	2103-9902
11A12 D102	Rectifier, bridge;.....	2103-9902
11A12 R101 thru 11A12 R104	Resistor, 0.1Ω±10% 15W wire-wound;.....	0282-0100
11A12 R105 thru 11A12 R108	Resister, 2kΩ±5% ½W composition.....	0032-4200

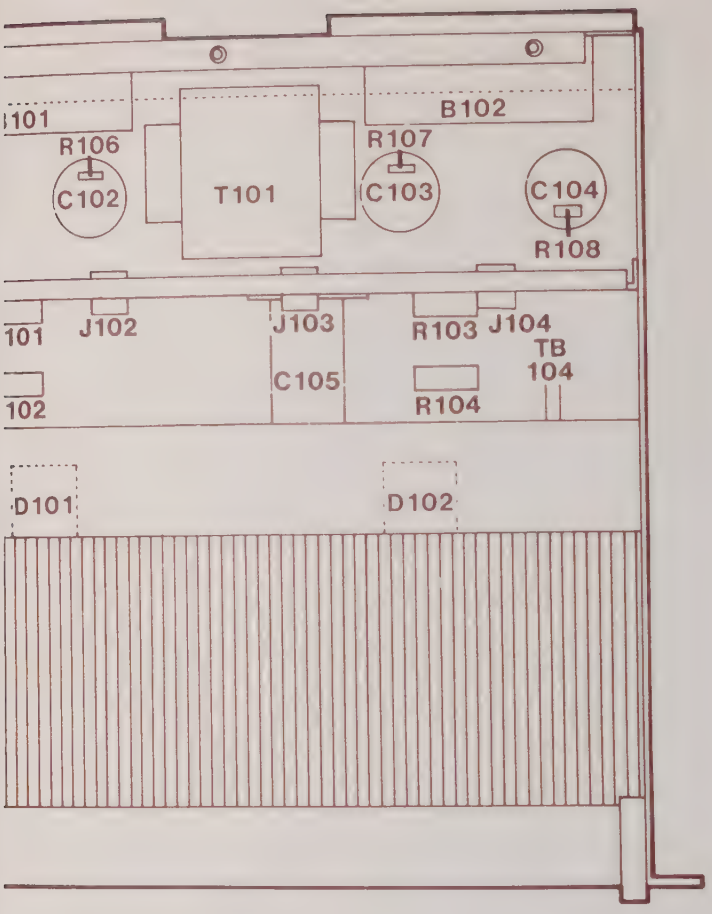
Ref Des	Description	Tau-Tron No.
11A12 R109	VA-01 only: Resistor, 0.1Ω±15W wire-wound;.....	0281-0100
11A12 T101	Transformer, power;.....	9010-6599
11A12 TB101 thru 11A12 TB104	Terminal strip, 6 lug.....	9110-0101
11A21	**REAR PANEL**	
11A21	Rear panel.....	9705-3690
11A21	Fan filer;.....	9000-0252
	Secured to rear panel by two brackets;.....	9000-0253
	Covered by screen assy;.....	9000-0254
11A21 F101	Fuse, 3A slo-blo for 115V power.....	9000-0106
	Fuse, 1.5A slo-blo for 230V power.....	9000-0101
	Uses fuseholder.....	9000-0102
11A21 J105	Connector, ac power connector and line filter.....	9000-0001
11A21 S101	Switch, slide, dpdt.....	9000-0000
11A31	**FRONT PANEL**	
11A31	Power switch panel.....	9705-3168
11A31	Locking bar assy.....	9705-4339
11A31 DS102	Part of S102	
11A31 S102	Switch, toggle, spst illuminated, includes DS102.....	9205-0001

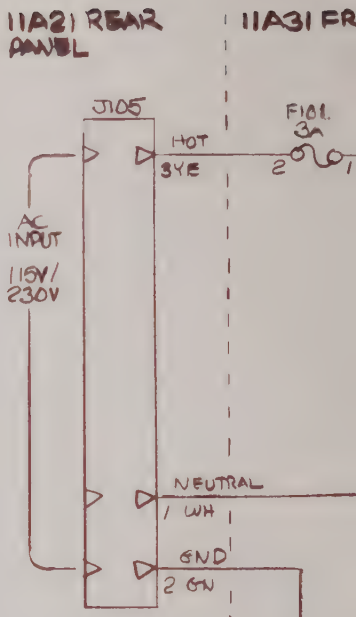
Diagrams

11.600 **CONTENTS**

11A11 Frame.....page ---
11A12 Supply..... 11-603
11A21 Rear Panel..... ---
11A31 Front Panel..... ---


S101
(TOP)
F101
(CENTER)
J101
(BOTTOM)
R105
TB
101
C101
J101
TB
102
TB
103
S102





PARTS VALUES

Unless noted otherwise

C in μF
L in μH
R in Ω
• special, see parts list

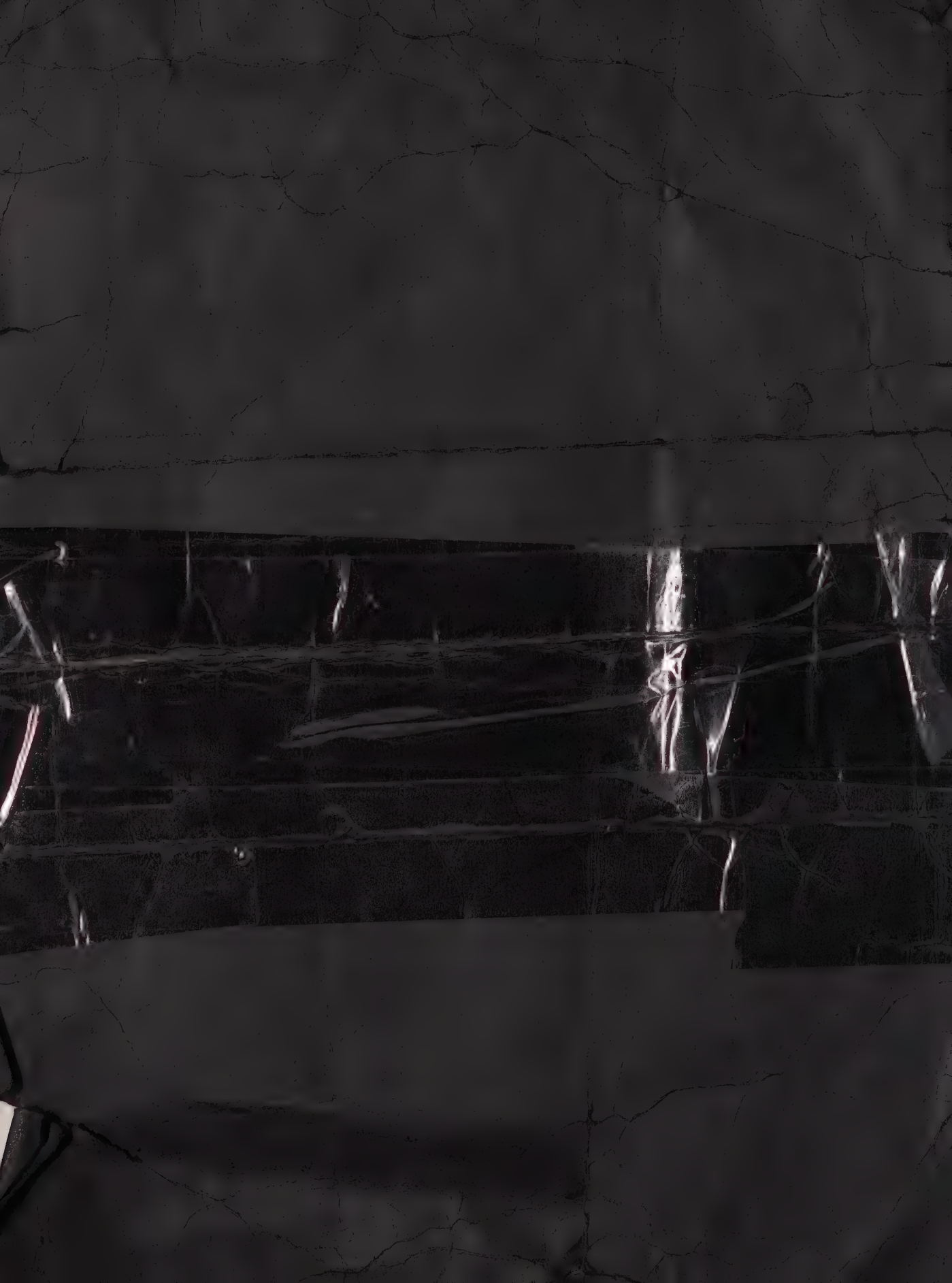
For full type numbers of ICs and transistors, see parts list

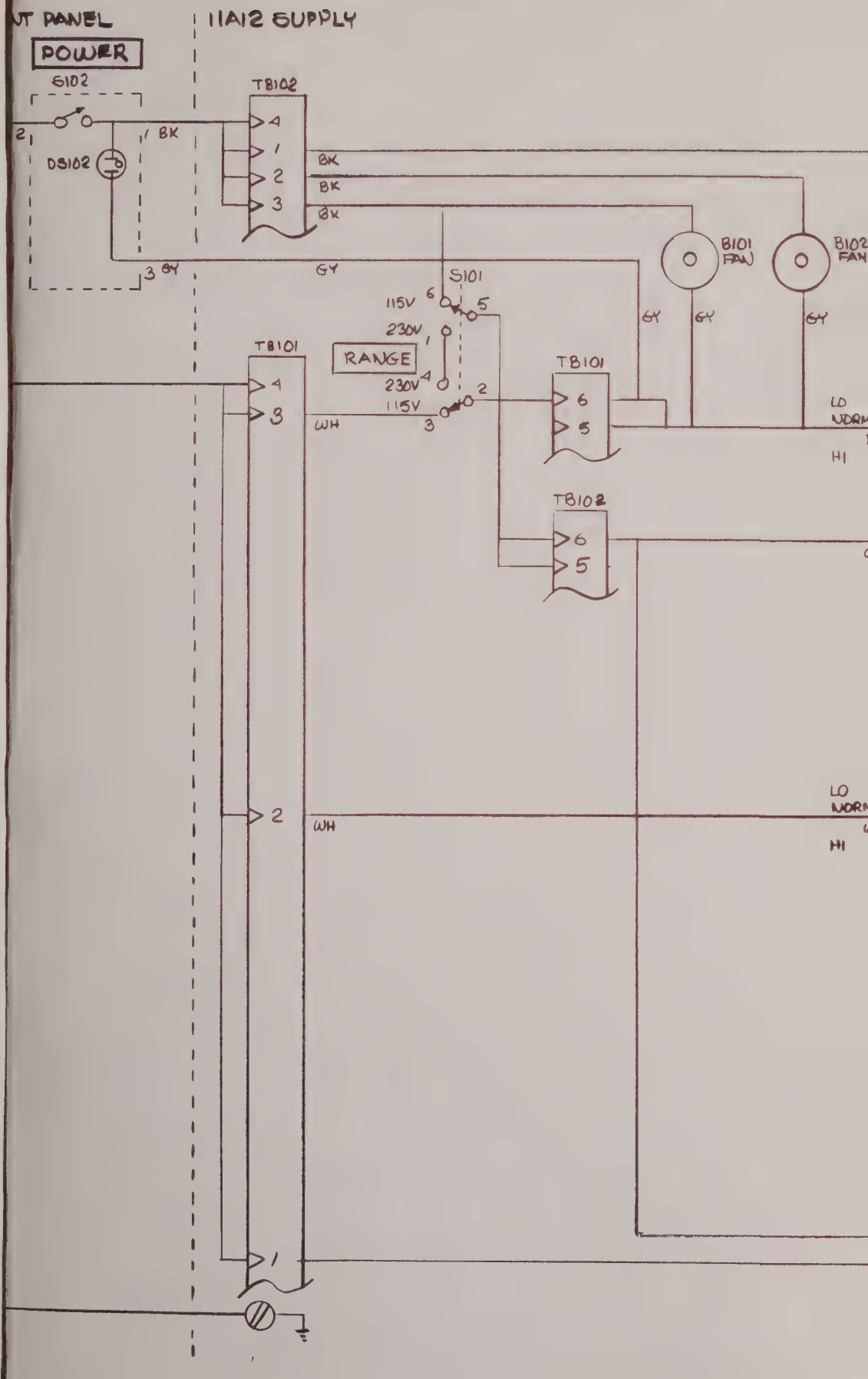
REFERENCE DESIGNATIONS

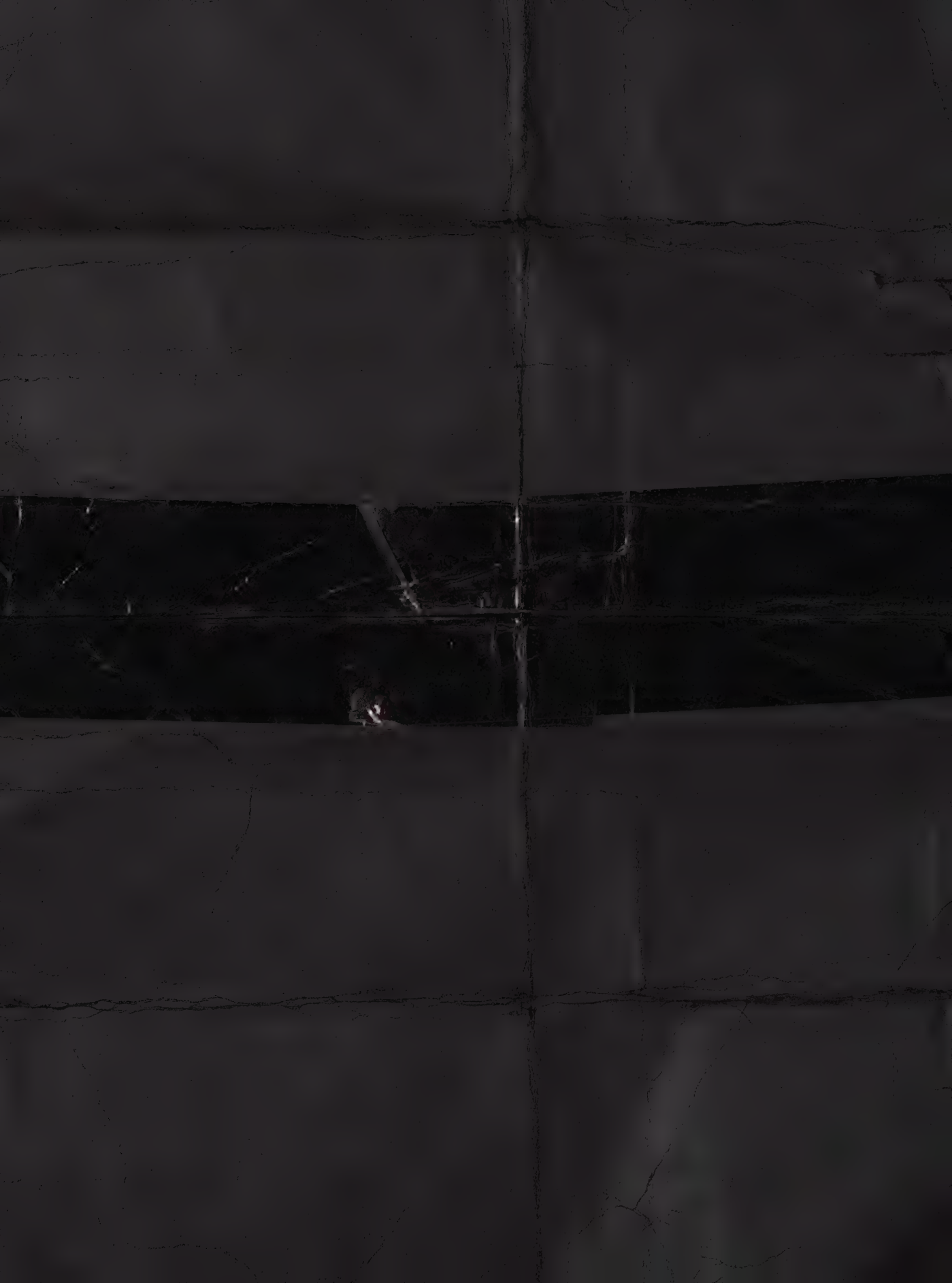
Full reference designations include assembly prefix

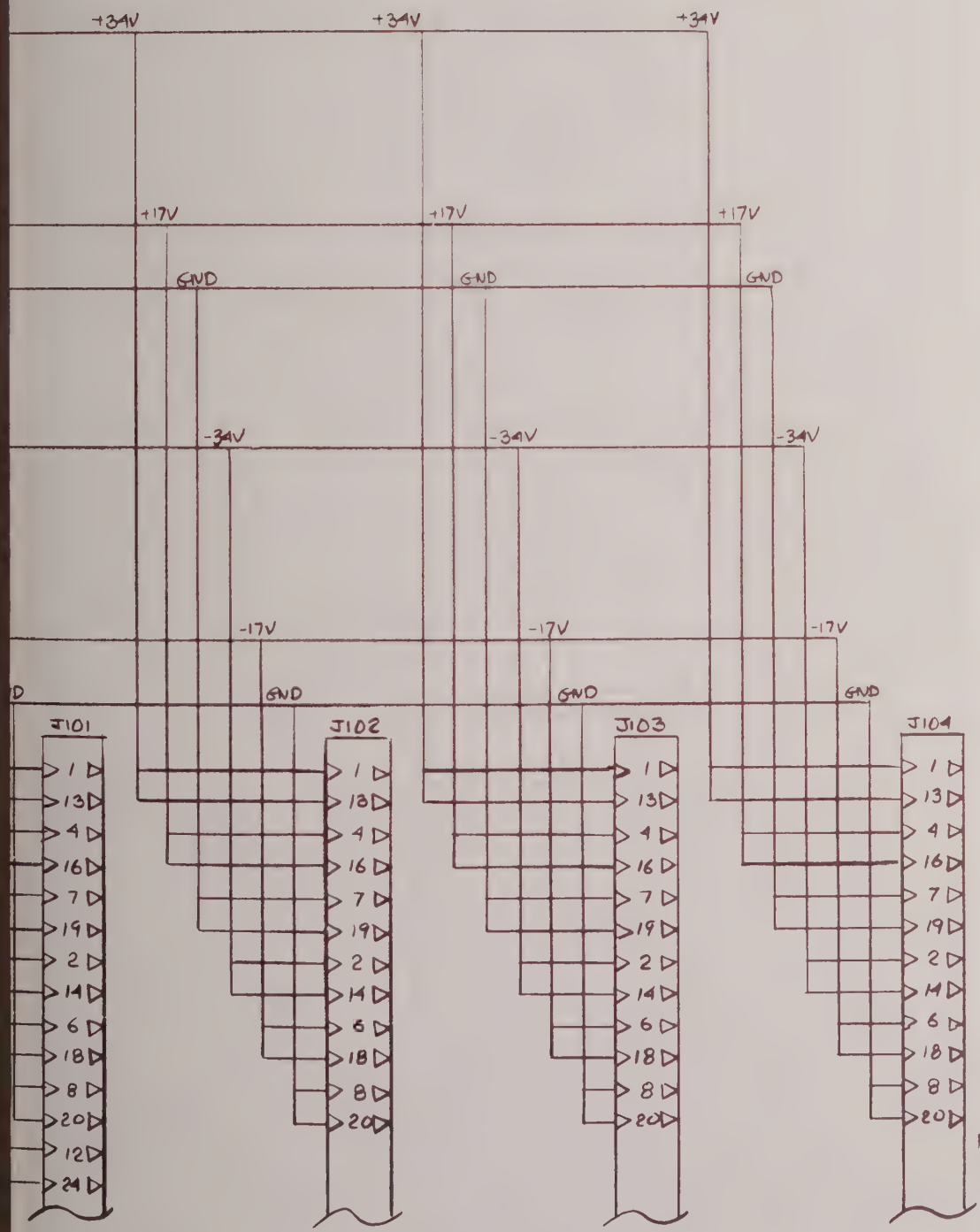
SIGNAL ORIGIN

⋗— input
—⋗ output




JT PANEL
11A12 SUPPLY
POWER
S102
TB102
DS102
BK
GY
S101
115V
230V
RANGE
TB101
WH
B101 FAN
B102 FAN
LO
HI





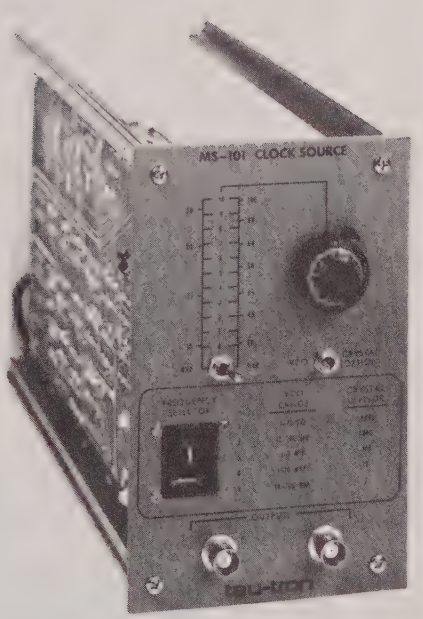
Form 0152-
TAU-TRON
MF-2
1 of 1 **11A12**
SUPPLY

Changes

11.700 **CONTENTS**

Where not contained in the body of the manual, information on options, variations, and modifications is contained in this section.

tau-tron
A UNIT OF GENERAL SIGNAL



CONFIGURATION

Your unit is **serial number** _____ and is configured as follows (information on these differences is contained in the body of the manual and/or in the rear of the manual under Changes):

Options:

__ OP-01A ECL into 50Ω to -2V
__ OP-01B ECL into 50Ω to gnd
__ OP-01C ECL into 100Ω to -2V
__ OP-01D ECL into 100Ω to gnd

__OP-04A_____MHz crystal
__OP-04B_____, _____MHz crystal
__OP-04C_____, _____, _____MHz crystal

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Theory..... 21-301
Service..... 21-401
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MS-101
CLOCK SOURCE

INSTRUCTION MANUAL
Form 0153-0781C

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(617) 256-9013 Telex 951952

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21.110 Installation..... 21-103

21.101 SCOPE

This instruction manual provides operation and maintenance information for the Tau-Tron MS-101 Clock Source Module, including all options, variations,serial numbers, and modifications.

21.102 DESCRIPTION

The Tau-Tron MS-101 Clock Source Module is a quarter-size Tau-Tron Modular Instrument that generates a clock signal continuously variable from 1kHz to 100 MHz.

21.103 SPECIFICATIONS

Variable Frequencey	1kHz to 100MHz, continuously variable by means of three front panel controls in 10 ranges with 1,3 sequence.
Crystal Frequency Options OP-04A, 04B, and 04C	1 to 100MHz supplied by one (OP-04A), two (OP-04B), or three (OP-04C) optional crystal-controlled oscillators, front-panel switch sets variable or crystal-controlled mode. Internal switch sets which of the three oscillators is in-circuit when two or more are installed. Output frequency can be divided down by 1,10,100,1000, or 10,000 as set by front-panel thumbwheel switch.
Amplitude	TMI level of 2±0.3V into 50Ω to ground with baseline of 0±0.2V, standard.Optional output levels include TTL levels into 50Ω to ground, ECL levels into 50 or 100Ω to ground or to -2V. Available at 2 paralleled front-panel BNC connectors.
Shape	Square except 10-30MHz variable range which has a 33% duty cycle. Transition times of 3.5ns max, and distortion of ±7% max, terminated.

Power	+17V nominal at 0.2A, -17V nominal at 0.7A, both unregulated and both supplied by mainframe.
Cooling	Forced air, supplied by mainframe.
Mechanical	TMI quarter-size module, DIMENSIONS: 6.375 in. high 4 in. wide 11 in. deep. WEIGHT: 2 lb. net, 4 lb. shipping.

21.104 **WARRANTY**

All Tau-Tron products are warranted against any defects in material and workmanship. This warranty applies for one year from the date of delivery for all Tau-Tron manufactured products. The warranty period for OEM products sold by Tau-Tron will depend on the original OEM warranty (consult factory for specific products). We will repair or replace products which, upon our examination, prove to be defective during the warranty period.

NO OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING FITNESS FOR PURPOSE, MERCHANTABILITY OR OTHERWISE, IS GIVEN.

For any assistance, contact Customer Service with details of the instrument model, serial numbers, and malfunction, see Repair Returns below.

21.105 **SHIPPING DAMAGE**

If any signs of damage are noted on the outside of the carton, request the carrier's agent to be present during unpacking. If external damage is found on the instrument follow Repair Returns procedure below.

Check out the electrical performance of the instrument as soon as possible after receipt. If any malfunctions are observed, follow Repair Return procedure below.

21.106 **REPAIR RETURNS**

For mechanical damage or electrical malfunctions, notify Tau-Tron immediately and if the damage occurred during shipping, also notify the carrier. To return a unit for repair:

1. Call the Customer Service Dept., (617)256-9013, for a Repair Authorization Number. This will reduce administrative delays and ensure prompt return of your unit.
2. Complete and attach the Repair Tag, in the rear of the manual, to your unit for positive identification.
3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb) and shock absorbing material such as bubblewrap to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.
4. Send to: Tau-Tron
   27 Industrial Ave.
   Chelmsford, MA 01824
   Attn: Customer Service

21.107 **ASSISTANCE**

For service assistance call the Tau-Tron Customer Service Dept., (617)256-9013. Their experience and expertise can often save you valuable time in correcting any equipment malfunction.

21.108 **POWER**

CAUTION Be sure the line switch on the rear panel of the mainframe is set to the proper range (115 or 230V) before connecting to the ac line. If the incorrect range is selected, the instrument could be damaged.

All power for the module is supplied by the mainframe upon insertion of the module.

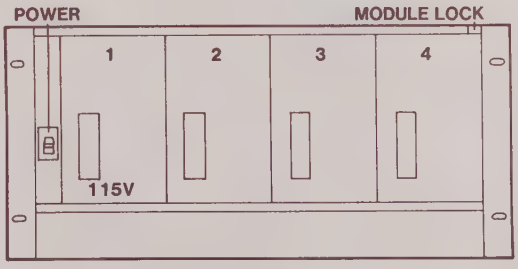
21.109 **SITE REQUIREMENTS**

Power	All power is supplied by the mainframe which requires 90 to 135V or 180 to 270V, 50 to 60Hz ac.
Temperature	32 to 113°F (0 to 45°C).
Humidity	0 to 95% RH max at 20°C, non-condensing.
Clearances	Cooling is supplied by the mainframe. The only clearances required by the module are those necessary for access to the front-panel operating controls.

21.110 **INSTALLATION**

Module Insertion

1. Pull out the Module Lock knob.
2. Insert the module as required.
3. Push in the Module Lock knob.



The module(s) can be inserted in any position desired except any user-built module that requires ac power must connect to the position -1 connector. In general, systems shipped by Tau-Tron have modules inserted in the following order:

Position 1.....Clock
Position 2.....Transmitter
Position 3.....Receiver

Module Removal

1. Pull out the Module Lock knob.
2. Grasp the module to be removed by its front-panel BNC connector(s) and pull to remove.
3. Push in the Module Lock knob to prevent the remaining modules from accidently falling out.

Crystal-Oscillator Selection (OP-04B, C only)

When two or more crystal-controlled oscillators are installed, only one at a time can be placed in-circuit by the front-panel VCO crystal switch. The one selected is set by an internal slide switch. To set this switch, proceed as follows:

1. Turn mainframe Power switch off.
2. Pull out mainframe Module Lock knob.
3. Grasp MS-101 by its front panel BNC connectors and pull out module about two thirds of its length.
4. On the upper part of the printed-circuit board, about in the middle is a slide switch. This slide switch determines which of the oscillators is to be placed in-circuit by the VCO-CRYSTAL switch:

   Front Position...Oscillator 1
   Center Position..Oscillator 2
   Rear Position....Oscillator 3 (OP-04C only)

Inter Connections

The MS-101 OUTPUT is normally connected to the input of a generator by means of a BNC terminated cable of the shortest practical length.

21.200 **CONTENTS**

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21.202 Continuous Frequencies.. 21-202
21.203 Crystal Frequencies..... 21-202

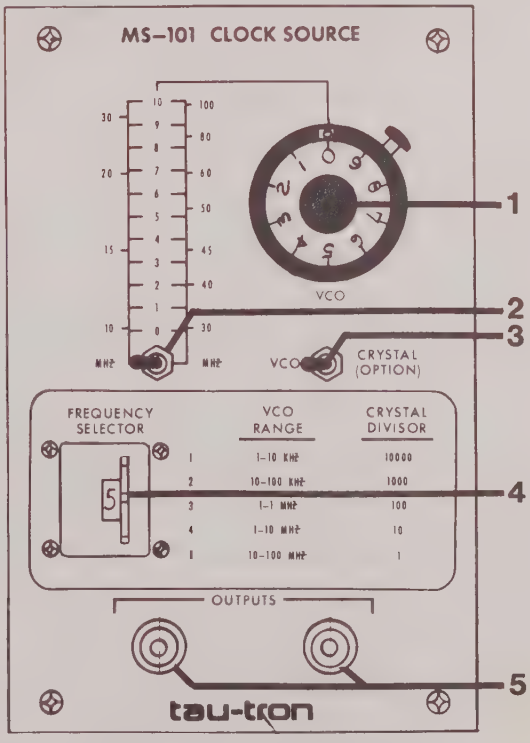
21.201 **FRONT PANEL**

1 VCO — Ten-turn potentiometer sets the output frequency of the clock from 1kHz to 100MHz over a 3-to-1 range in conjunction with the Scale Selector (2) and FREQUENCY SELECTOR (3). This control has no effect in the CRYSTAL setting of the VCO-CRYSTAL switch.

2 SCALE SELECTOR — Two-position toggle switch selects the lower VCO range of from 10 to 30 (left position) or the upper VCO range of from 30 to 100 (right position). This switch has no effect in the CRYSTAL setting of the VCO-CRYSTAL switch.

3 VCO — Two-position toggle switch selects basic operating mode of clock-voltage-controlled oscillator (left VCO position) or crystal-controlled oscillator (right CRYSTAL position).

The crystal-controlled mode of operation is optional (OP-04) and can include up to three crystal-controlled oscillators. Only one of these oscillators at a time can be placed in-circuit by the VCO CRYSTAL switch. When two or more oscillators are included (OP-4B or OP-4C) the one selected for control by the VCO-CRYSTAL switch is set by an internal slide switch.



4 FREQUENCY SELECTOR — Five-position thumbwheel switch selects the frequency range of from 1kHz to 100MHz in five decade steps when the VCO-CRYSTAL switch is set to VCO. When the VCO-CRYSTAL switch is set to CRYSTAL, the FREQUENCY SELECTOR switch divides down the crystal-oscillator by from 1 to 10,000 in five decade steps.

5 OUTPUTS Two paralleled BNC connectors, provide the output signal from the module at a standard TMI level of 2±0.3V into 50Ω to ground. The output of the clock is normally connected to the input of a generator.

Optionally, other levels may be substituted, including:
OP-01A ECL level of 0.8V into 50Ω to -2V.
OP-01B ECL level of 0.8V into 50Ω to ground.
OP-01C ECL level of 0.8V into 100Ω to -2V.
OP-01D ECL level of 0.8V into 100Ω to ground.

21.202 **CONTINUOUS FREQUENCIES**

Any OUTPUT frequency between 1kHz and 100MHz can be selected as follows:

1. Set the VCO CRYSTAL switch to VCO.
2. Set the FREQUENCY SELECTOR thumbwheel switch to the required range as determined by the associated VCO RANGE table.
3. Set the Scale Selector switch to the lower or upper VCO range as determined by the associated nomenclature for the switch.
4. Set the VCO potentiometer to the required number as determined by the nomenclature associated with the Scale Selector switch.

For example, for an output of 15kHz, set the controls as follows:

FREQUENCY SELECTOR....2
Scale Selector.....10-30
VCO potentiometer.....3.5

21.203 **CRYSTAL FREQUENCIES**

Any OUTPUT frequency from 100Hz to 100MHz, depending on the crystal(s) installed, can be selected as follows:

1. Set the VCO-CRYSTAL switch to CRYSTAL.
2. Set the FREQUENCY SELECTOR thumbwheel switch to the desired divisor as determined by the associated CRYSTAL DIVISOR table.

For example, for an output of 1.544kHz with a crystal-oscillator frequency of 1.544MHz (T1), set the controls as follows:

FREQUENCY SELECTOR....2

21.300 CONTENTS

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21.302 Prescaler..... 21-301
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21.304 Decade Divider..... 21-302
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21.301 VC OSCILLATOR

Diagram 21A41

UA2 is the voltage-controlled oscillator, an ECL oscillator whose frequency is controlled over a 3-to-1 range by a changing of the voltage applied to its frequency-determining tank circuit L4 and varactor diodes D1 and D2. The VCO potentiometer R501 changes this voltage, and its range is set by R1 and R2 to provide a frequency range of 29 to 101MHz.

21.302 PRESCALER

Diagram 21A41

In the 30-100 range of the Scale Selector switch S502, the Prescaler UB2 is inhibited by grounding UB2 pin 13 through S502 and D3. The full frequency output of the VC Oscillator passes through UB3 pins 7,3,5,2,10, and 14 to the input of the Decade Dividers at UB3 pin 12.

In the 10-30 range of the Scale Selector switch S502, UB3 at pin 6 is inhibited by grounding it through S502 and D3 and the Prescaler UB2 is enabled. The full frequency output of the VC Oscillator is applied to the input of the Prescaler UB2 pin 9. The Prescaler divides the input by 3, and applies it to UB3 pin 4 where it proceeds to the input of the Decade Divider at UB3 pin 12.

21.303 CRYSTAL OSCILLATORS

Diagram 21A41

Optionally, the unit can include from 1 to 3 crystal-controlled oscillators (OP-04); all three operate in the same manner but will be explained in terms of the first.

The oscillator consists of an emitter-coupled pair Q5 and Q6. Coupling is by means of a series resonant circuit C22 and Y1 which presents the lowest impedance, and therefore the highest signal, at the resonant frequency. The signal appears at Q6 collector in-phase with its input at the emitter and is coupled to Q5 base whose output at the emitter is in-phase with the input at the base. Parallel-resonant circuit L1 and C23 offers the highest impedance to ground, and therefore the highest signal level from C6 collector to Q5 base, at the resonant frequency; unwanted off-resonance frequencies are shunted to ground. The frequency of Y1 is optional from 1 to 100 MHz and the value of L1 varies with the frequency chosen for Y1.

Only one oscillator is enabled at one time as selected by the Oscillator Selector S1 or an associated jumper which provides the necessary base ground return for the transistors.

The output from each oscillator is applied to the input of and-gate UB1 which is inhibited when the VCO CRYSTAL switch is set to VCO and enabled when it is set to CRYSTAL. The output of UB1 is applied to the input of the Decade Divider UA2 pin 13.

21.304 **DECADE DIVIDER**

Diagram 21A41

The output from the VC Oscillator or Crystal Oscillators as selected by the VCO-CRYSTAL switch S503, are applied to the input of the Decade Divider UB3 pin 12 or 13.

The Decade Divider consists of 4 divide-by-10 circuits (UC3, UC2, UD2, UE2, and UF2) and provide divisions of from 1 (all dividers by-passed) to 10,000 (all dividers cascaded) as selected by the FREQUENCY SELECTOR thumbwheel switch S501 which enables the appropriate gate UC4 output pins 3 or 2, or UD3 output pins 10,4, or 1.

21.305 **OUTPUT**

Diagram 21A41

The output from the Decade Divider is applied to two identical paralled output circuits that provide output signals of nominally 2V behind 50Ω to two front-panel BNC OUTPUT connectors J501 and J502.

21.306 **REGULATOR**

Diagram 21A31

Unregulated + or -17V from the mainframe power supply is applied to pins 4 and 16 and 6 and 18 respectively. Regulators VR601 and VR602 connected to these pins provide regulated +5V and -5.2V for the circuits in the module.

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21.402 VC Oscillator Adjust..... 21-401
21.403 Crystal Oscillator Adjust.. 21-401
21.404 Test Procedure..... 21-402

21.401 ROUTINE SERVICE

None required.

21.402 VC OSCILLATOR ADJUST

The VC Oscillator is factory adjusted for a range of 29 to 101MHz. This adjustment is quite stable and does not require readjustment under ordinary circumstances. For extraordinary circumstances and as a matter of interest, readjustment is as follows:

1. With a 50Ω terminated BNC cable, connect the OUTPUT to a frequency counter.

2. Set the controls as follows:

   VCO-CRYSTAL.....VCO
   FREQUENCY SELECTOR..5
   Scale Selector.....30-100
   VCO Potentiometer...0.00

3. Adjust the Hi potentiometer R2 for 29MHz as indicated on the counter.

4. Set the VCO Potentiometer to 10.00 and adjust the Lo potentiometer R1 for 101MHz.

5. These two adjustments interact, repeat their adjustments, if necessary for a frequency range of 29 to 101MHz.

21.403 CRYSTAL OSCILLATOR ADJUST

Option OP-04 only.

The crystal and parallel-resonant inductor are factory selected and the tuning capacitor is factory adjusted for the user-requested frequency of each oscillator. These components and the adjsutment are quite stable and do not require reselection or readjustment unless a different frequency is desired. Readjustment is as follows:

1. If necessary, set the internal slide switch to the desired oscillator (Options OP-04B and -04C); see paragraph 21.110 Crystal Oscillator Selection.

2. With a 50Ω terminated BNC cable, connect the OUTPUT to a frequency counter.

3. Set the controls as follows:

   VCO-CRYSTAL.....CRYSTAL
   FREQUENCY SELECTOR...5

4. Adjust the appropriate variable capacitor (C23, C29, or C35) for the correct frequency.

21.404 TEST PROCEDURE

The specifications given are those necessary to perform the tests and are not necessarily those of the suggested equipment.

Equipment

a. Mainframe	Tau-Tron Modular Instrument (TMI) MF-2, MF-3, or MF-5 Mainframe.
b. Autotransformer	Capable of varying ac line ±10%, 300W, with output ac voltmeter.Variac W5MT with separate voltmeter (230V line).
c. Voltmeter	4.3 to 5.3V dc, 5000Ω/V. Triplett 630.
d. Oscilloscope	1.8ns risetime, 25mV to 2V/div sensitivity. Tektronix 475.
e. Frequency Counter	1kHz to 100MHz, 2V p-to-p sensitivity. Hewlett Packard 5382A.
f. 50Ω Termination	50Ω termination with BNC connectors. Kings 1340-1.

Procedure

1 Initial setup

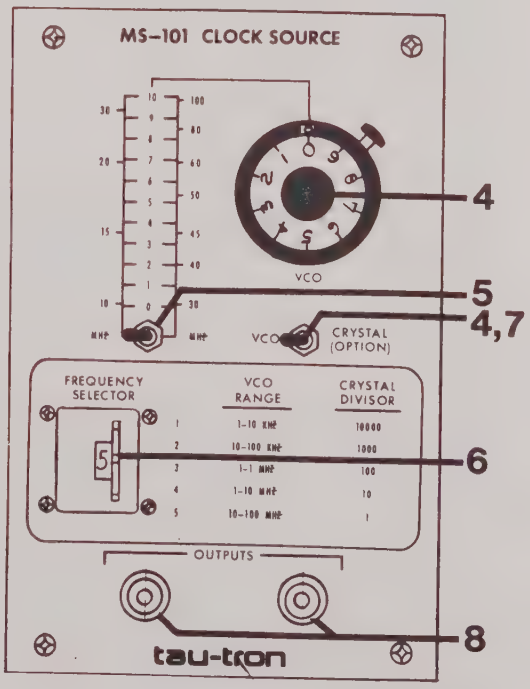
Turn off the mainframe, remove all modules, and connect the mainframe to a variable ac line.

Insert the MS-101 into the first position of the mainframe (left most, next to the power switch panel).

2 +5V supply

Connect a dc voltmeter and an oscilloscope to the output of the +5V regulator (VR601 emitter pin 2).

Set the ac line for the nominal supply voltage (100,115,125,200,230, or 250V) and turn on the mainframe power; the +5V supply must be +4.9 to +5.1V and ripple must not exceed 50mV p-to-p max, 120Hz.



Reduce the line voltage to the low end (90,105,115,180,210, or 230V); the +5V supply must remain within 0.1V of +5V and ripple must remain at or below 50mV p-to-p.

Increase the line voltage to the high end (110,125,135,220,250, or 270V); the +5V supply must remain within 0.1V of +5V and ripple must remain at or below 50mV p-to-p.

3 -5.2V supply

Change the dc voltmeter and oscilloscope to the output of the -5.2V regulator (VR602 emitter pin 2) and set the ac line for the nominal supply voltage; the -5.2V supply must be -5.1 to -5.3V and ripple must be 50mV p-to-p max, 120Hz.

Reduce the line voltage to the low end; the -5.2V supply must remain within 0.1V of -5.2V and ripple must remain at or below 50mV p-to-p.

Increase the line voltage to the high end; the -5.2V supply must remain within 0.1V of -5.2V and ripple must remain at or below 50mV p-to-p.

Disconnect the voltmeter and oscilloscope from the output of the -5.2V regulator and return the line voltage to its nominal value.

4 VCO

Connect dc voltmeter to the negative end of the VCO potentiometer at E2.

VCO CRYSTAL.....VCO
Scale Selector.....30-100
FREQUENCY SELECTOR.5 (10-100MHz)
VCO.....0.0 (fully ccw)
OUTPUT.....Connect to frequency counter input

Output frequency must be 29MHz±.

Change VCO to 10.0 (fully cw). Output frequency must be 101MHz±.

If frequency range is improper, adjust R2 for low end and R1 for high end. These adjustments interact and must be repeated for required frequency range. The voltage at the negative end of the VCO potentiometer at E2 must not be set more negative than -4.2V.

Disconnect dc voltmeter.

5 Scale Selector

VCO.....10
VCO CRYSTAL.....Leave at VCO
Scale Selector.....Leave at 30-100
FREQUENCY SELECTED.Leave at 5
OUTPUT.....Leave at frequency counter input.

Set VCO for a frequency of 99MHz on the frequency counter. Change Scale Selector to 10-30. Frequency counter must now read 9.9MHz, indicating a division by 3.

6 FREQUENCY SELECTOR

Scale Selector.....10-30
VCO.....10
VCO-CRYSTAL.....Leave at VCO
FREQUENCY SELECTOR.Leave at 5
OUTPUT.....Leave at frequency counter input

Set VCO for a frequency of 10MHz on the counter and change the FREQUENCY SELECTOR as follows:

FREQUENCY SELECTOR	FREQUENCY COUNTER
5	10MHz
4	1MHz
3	100MHz
2	10KHz
1	1KHz

Change Scale Selector to 30-100, set VCO for a frequency of 10KHz on frequency on the counter, and change the FREQUENCY SELECTOR as follows:

FREQUENCY SELECTOR	FREQUENCY COUNTER
1	10KHz
2	100KHz
3	1MHz
4	10MHz
5	100MHz

7 CRYSTAL frequency (OP-04 only)

VCO CRYSTAL FREQUENCY SELECTED.5
Scale Selector.....30-100
VCO.....10
OUTPUT.....Leave at frequency counter input

CRYSTAL

Check oscillator(s) for proper frequency. For OP-04B and OP-04C, set the internal slide switch for each of the two or three different oscillator outputs. The frequency of each oscillator can be varied slightly by means of a variable capacitor in each oscillator circuit (C23, C29, and C35).

8 OUTPUTS

OUTPUT — Disconnect from frequency counter, and connect to input of oscilloscope, terminated in 50Ω.

VCO-CRYSTAL.....CRYSTAL
FREQUENCY SELECTOR..Leave at 5
Scale Selector.....Leave at 30-100
VCO.....10

OUTPUT must have the following characteristics:

Baseline.....0V±0.2V
Amplitude..... -2V±0.3V, p-to-p
Duration.....5ns min
Transitions*.....3.5ns max, 10 to 90% points

Disconnect OUTPUT from oscilloscope and connect to other OUTPUT. Second OUTPUT must have same characteristics as the first.

*Note that the transition times as viewed on the oscilloscope are affected by the risetime of the oscilloscope as follows:

$$RT_{viewed} = \sqrt{RT_{device}^{2} + RT_{scope}^{2}}$$

a 3.5ns transition measured on an oscilloscope with a 1.8ns risetime such as a Tektronix 475, for example, would actually be viewed as 3.9n on the crt.

21.500 **CONTENTS**

21.501 Replaceable Parts..... 21-501

21.501 **REPLACEABLE PARTS**

Reference designations include unit and assembly prefixes.

Ref Des	Description	Tau-Tron No.
	FRAME	
21A11	Rails, four rails total, supplied in sets of two each (top and bottom), per set.....	9705-4018A
21A11	Shield, formed aluminum..... Secured to rails by four 5-40X.25in Phillips-head machine screws	9705-3395
21A21	**REAR PANEL**	
21A21	Panel only, drilled, without components..... Secured to rails by four 5-40X3/8in Phillips-head machine screws	9705-3531C
21A22	**REGULATOR**	
21A22 C602	Capacitor, 20% 200V .1 µF ceramic.....	1014-4610
21A22 C603	Capacitor, 20% 35V 1 µF tantalum.....	1024-5110
21A22 C604	Capacitor, 20% 35V 4.7 µF tantalum.....	1024-5147
21A22 C605	Capacitor, 20% 35V 1 µF tantalum.....	1024-5110
21A22 C606	Capacitor, 20% 35V 10 µF electrolytic.....	1024-5210
21A22 P603	Plug, 24-pin male, chassis mounted;.....	9300-0103
21A22 R603	Resistor, 300 Ω±5% ¼W composition.....	0022-3300
21A22 R604	Resistor, 12 Ω±5% ¼W composition.....	0022-2120
21A22 VR601	Voltage regulator, LM340K-05,+5V..... Uses Keystone 4006 TO-3 mounting socket Uses Thermolloy 4726A TO-3 annodized aluminum heatsink Uses two Motorola B515475002 nylon bushings Secured with two 6-32X½ in slotted hex-head self-tapping screws	4200-340K5

Ref Des	Description	Tau-Tron No.
21A22 VR602	Voltage regulator, LM320K-5.0,-5.2V..... Uses Keystone 4606 TO-3 mounting socket Uses Thermalloy 4726A TO-3 annodized aluminum heatsink Uses two Motorola B515475002 nylon bushings Secured with two 6-32X⅛in slotted hex-head self-tapping screws	4201-320K5
	FRONT PANEL	
21A31	Panel only, drilled, painted, silk-screened, without components..... Secured to rails by four 5-40X3/8in Phillips-head machine screws	9705-4090
21A31 J501	OUTPUT connector, BNC female.....	9301-0001
21A31 J502	OUTPUT connector, BNC female.....	9301-0001
21A31 R501	Potentiometer, 5 KΩ 10-turn..... Uses 10 turndial.....	0333-4500E 9802-4943
21A31 S501	FREQUENCY SELECTOR switch, 5-position thumbwheel..... Uses mounting hardware; EECO 97SG-5	9200-0040
21A31 S502	Switch, spdt toggle.....	9200-0005
21A31 S503	VCO-CRYSTAL switch, spdt toggle.....	9200-0005
21A41	**CLOCK SOURCE**	9601-0433
21A41 C1 thru C7	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C8	Capacitor, 10% 200V 47 pF ceramic.....	1013-8247
21A41 C9	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C10	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C11	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C12	Capacitor, 10% 200V 22 pF ceramic.....	1013-8222
21A41 C13	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C14	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C15	Capacitor, 10% 200V 22pF ceramic.....	1013-8222
21A41 C16	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C17	Capacitor, 20% 10V 33μF miniature tantalum.....	1064-1233
21A41 C18	Capacitor, 20% 10V 33μF miniature tantalum.....	1064-1233
21A41 C19	OP-04A,B,C only: Capacitor, 20% 50V .01μF chip bypass...	1084-4710
21A41 C20	OP-04A,B,C only: Capacitor, 20% 50V .01μF chip bypass...	1084-4710
21A41 C21	OP-04A,B,C only: Capacitor, 20% 50V .01μF chip bypass...	1084-4710
21A41 C22	OP-04A,B,C only: Capacitor, 10% 200V 22 pF ceramic.....	1013-8222

Ref Des	Description	Tau-Tron No.
21A41 C23	OP-04A,B,C only: Capacitor, 350V 9 to 35 pF variable..	1059-8253
21A41 C24	OP-04A,B,C only: Capacitor, 20% 50V .01μF chip bypass.	1084-4710
21A41 C25	OP-04B,C only: Capacitor, 20% 50V .01μF chip bypass...	1084-4710
21A41 C26	OP-04B,C only: Capacitor, 20% 50V .01μF chip bypass...	1084-4710
21A41 C27	OP-04B,C only: Capacitor, 20% 50V .01μF chip bypass...	1084-4710
21A41 C28	OP-04B,C only: Capacitor, 10% 200V 22 pF ceramic.....	1013-8222
21A41 C29	OP-04B,C only: Capacitor, 350V 9 to 35pF variable.....	1059-8253
21A41 C30	OP-04B,C only: Capacitor, 20% 50V .01 μF chip bypass...	1084-4710
21A41 C31	OP-04C only: Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C32	OP-04C only: Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C33	OP-04C only: Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C34	OP-04C only: Capacitor, 10% 200V 22pF ceramic.....	1013-8222
21A41 C35	OP-04C only: Capacitor, 350V 9 to 35 pF variable.....	1059-8253
21A41 C36	OP-04C only: Capacitor, 20% 50V .01μF bypass.....	1084-4710
21A41 C42	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C801 thru C820	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 C901 thru C928	Capacitor, 20% 50V .01μF chip bypass.....	1084-4710
21A41 D1	Diode.....	2143-1403
21A41 D2	Diode.....	2143-1403
21A41 D3	Diode.....	2112-4148
21A41 D4	Diode.....	2112-4148
21A41 E1 thru E3	Terminal post, male.....	9303-0003
21A41 E7 thru E19	Terminal post, male.....	9303-0003
21A41 L1	OP-04A,B,C only: Inductor, value depends on frequency of Y1	
21A41 L2	OP-04B,C only: Inductor, value depends on frequency of Y2	
21A41 L3	OP-04C only: Inductor, value depends on frequency of Y3	
21A41 L4	Inductor, 120 nH.....	5083-3312
21A41 Q1	Transistor.....	3302-2784
21A41 Q2	Transistor.....	3224-5771
21A41 Q3	Transistor.....	3224-2784
21A41 Q4	Transistor.....	3224-5771
21A41 Q5	OP-04A,B,C only: Transistor.....	3224-5771

Ref Des	Description	Tau-Tron No.
21A41 Q6	OP-04A,B,C only: Transistor	3224-5771
21A41 Q7	OP-04B,C only: Transistor	3224-5771
21A41 Q8	OP-04B,C only: Transistor	3224-5771
21A41 Q9	OP-04C only: Transistor	3224-5771
21A41 Q10	OP-04C only: Transistor	3224-5771
21A41 R1	Potentiometer, 2kΩ	0333-4200A
21A41 R2	Potentiometer, 2kΩ	0333-4200A
21A41 R3	Resistor, 51kΩ ±5% 1/8W composition	0012-5510
21A41 R4	Resistor, 130Ω ±5% 1/8W composition	0012-3130
21A41 R5	Resistor, 3kΩ ±5% 1/8W composition	0012-4300
21A41 R6	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R7	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R8	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R9	Resistor, 820Ω ±5% 1/8W composition	0012-3820
21A41 R10	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R11	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R12	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R13	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R14	Resistor, 470Ω ±5% 1/8W composition	0012-3470
21A41 R15	Resistor, 470Ω ±5% 1/8W composition	0012-3470
21A41 R16	Resistor, 470Ω ±5% 1/8W composition	0012-3470
21A41 R17	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R18	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R19	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R20	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R21	Resistor, 470Ω ±5% 1/8W composition	0012-3470
21A41 R22	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R23	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R24	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R25	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R26	Resistor, 470Ω ±5% 1/8W composition	0012-3470
21A41 R27	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R28	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R29	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R30	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R31	Resistor, 3kΩ ±5% 1/8W composition	0012-4300
21A41 R32	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R33	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R34	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R35	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R36	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R37	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R38	Resistor, 160Ω ±5% 1/8W composition	0012-3160
21A41 R39	Resistor, 270Ω ±5% 1/8W composition	0012-3270
21A41 R40	Resistor, 160Ω ±5% 1/8W composition	0012-3160

Ref Des	Description	Tau-Tron No.
21A41 R41	Resistor, 270Ω ±5% 1/8W composition.....	0012-3270
21A41 R42	Resistor, 160Ω ±5% 1/8W composition.....	0012-3160
21A41 R43	Resistor, 39Ω ±5% 1/8W composition.....	0012-2390
21A41 R44	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
21A41 R45	Resistor, 180Ω ±5% 1/8W composition.....	0012-3180
21A41 R46	Resistor, 270Ω ±5% 1/8W composition.....	0012-3270
21A41 R47	Resistor, 39Ω ±5% 1/8W composition.....	0012-2390
21A41 R48	Resistor, 240Ω ±5% 1/8W composition.....	0012-3240
21A41 R49	Resistor, 270Ω ±5% 1/8W composition.....	0012-3270
21A41 R50	Resistor, 39Ω ±5% 1/8W composition.....	0012-2390
21A41 R51	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
21A41 R52	Resistor, 180Ω ±5% 1/8W composition.....	0012-3180
21A41 R53	Resistor, 270Ω ±5% 1/8W composition.....	0012-3270
21A41 R54	Resistor, 39Ω ±5% 1/8W composition.....	0012-2390
21A41 R55	Resistor, 240Ω ±5% 1/8W composition.....	0012-3240
21A41 R56	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
21A41 R57	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
21A41 R58	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
21A41 R59	Resistor, 1.5kΩ ±5% 1/8W composition.....	0012-4150
21A41 R60	Resistor, 1.1kΩ ±5% 1/8W composition.....	0012-4110
21A41 R61	Resistor, 2kΩ ±5% 1/8W composition.....	0012-4200
21A41 R62	Resistor, 1.5kΩ ±5% 1/8W composition.....	0012-4150
21A41 R63	Resistor, 1.1kΩ ±5% 1/8W composition.....	0012-4110
21A41 R64	Resistor, 2kΩ ±5% 1/8W composition.....	0012-4200
21A41 R65	OP-04A,B,C only: Resistor, 2kΩ ±5% 1/8W composition...	0012-4200
21A41 R66	OP-04A,B,C only: Resistor, 2kΩ ±5% 1/8W composition...	0012-4200
21A41 R67	OP-04A,B,C only: Resistor, 750Ω ±5% 1/8W composition....	0012-3750
21A41 R68	OP-04A,B,C only: Resistor, 470Ω ±5% 1/8W composition...	0012-3470
21A41 R69	OP-04A,B,C only: Resistor, 10kΩ ±5% 1/8W composition...	0012-5100
21A41 R70	OP-04A,B,C only: Resistor, 1kΩ ±5% 1/8W composition...	0012-4100
21A41 R71	OP-04A,B,C only: Resistor, 2kΩ ±5% 1/8W composition...	0012-4200
21A41 R72	OP-04A,B,C only: Resistor, 240Ω ±5% 1/8W composition...	0012-3240
21A41 R73	OP-04A,B,C only: Resistor, 1.2kΩ±5% 1/8W composition...	0012-4120
21A41 R74	OP-04A,B,C only: Resistor, 1.5kΩ±5% 1/8W composition...	0012-4150
21A41 R75	OP-04B,C, only : Resistor, 2kΩ ±5% 1/8W composition...	0012-4200
21A41 R76	OP-04B,C only: Resistor, 2kΩ ±5% 1/8W composition...	0012-4200
21A41 R77	OP-04B,C only: Resistor, 750Ω ±5% 1/8W composition...	0012-3750
21A41 R78	OP-04B,C only: Resistor, 470Ω ±5% 1/8W composition...	0012-3470
21A41 R79	OP-04B,C only: Resistor, 10kΩ ±5% 1/8W composition...	0012-5100
21A41 R80	OP-04B,C only: Resistor, 1kΩ ±5% 1/8W composition...	0012-4100
21A41 R81	OP-04B,C only: Resistor, 2kΩ ±5% 1/8W composition...	0012-4200
21A41 R82	OP-04B,C only: Resistor, 240Ω ±5% 1/8W composition...	0012-3240
21A41 R83	OP-04B,C only: Resistor, 1.2kΩ±5% 1/8W composition...	0012-4120
21A41 R84	OP-04B,C only: Resistor, 1.5kΩ±5% 1/8W composition...	0012-4150
21A41 R85	OP-04C only: Resistor, 2kΩ ±5% 1/8W composition...	0012-4200

Ref Des	Description	Tau-Tron No.
21A41 R86	OP-04C only: Resistor, 2kΩ ±5% 1/8W composition...	0012-4200
21A41 R87	OP-04C only: Resistor, 750Ω ±5% 1/8W composition...	0012-3750
21A41 R88	OP-04C only: Resistor, 470Ω ±5% 1/8W composition...	0012-3470
21A41 R89	OP-04C only: Resistor, 10kΩ ±5% 1/8W composition...	0012-5100
21A41 R90	OP-04C only: Resistor, 1kΩ ±5% 1/8W composition...	0012-4100
21A41 R91	OP-04C only: Resistor, 2kΩ ±5% 1/8W composition...	0012-4200
21A41 R92	OP-04C only: Resistor, 240Ω ±5% 1/8W composition...	0012-3240
21A41 R93	OP-04C only: Resistor, 1.2kΩ±5% 1/8W composition...	0012-4120
21A41 R94	OP-04C only: Resistor, 1.5kΩ±5% 1/8W composition...	0012-4150
21A41 R97	Resistor, 270Ω ±5% 1/8W composition.....	0012-3270
21A41 R98	Resistor, 160Ω ±5% 1/8W composition.....	0012-3160
21A41 R99	OP-04A,B,C only: Resistor, 160Ω ±5% 1/8W composition..	0012-3160
21A41 R100	OP-04A,B,C only: Resistor, 270Ω ±5% 1/8W composition..	0012-3270
21A41 R101	OP-04B,C only: Resistor, 160Ω ±5% 1/8W composition..	0012-3160
21A41 R102	OP-04B,C only: Resistor, 270Ω ±5% 1/8W composition..	0012-3270
21A41 R103	OP-04C only: Resistor, 160Ω ±5% 1/8W composition.....	0012-3270
21A41 R104	OP-04C only: Resistor, 270Ω ±5% 1/8W composition.....	0012-3270
21A41 S1	OP-04B,C only: Switch, sp3t slide.....	9201-0005
21A41 UA2	Integrated circuit.....	4102-1648
21A41 UA3	Integrated circuit.....	4012-10216
21A41 UB1	Integrated circuit.....	4012-10109
21A41 UB2	Integrated circuit.....	4012-10231
21A41 UB3	Integrated circuit.....	4012-10102
21A41 UC2	Integrated circuit.....	4012-10125
21A41 UC3	Integrated circuit.....	4012-10138
21A41 UC4	Integrated circuit.....	4012-10102
21A41 UD2	Integrated circuit.....	4012-7490
21A41 UD3	Integrated circuit.....	4012-LS02
21A41 UD4	Integrated circuit.....	4012-10109
21A41 UE2	Integrated circuit.....	4012-74LS90
21A41 UE3	Integrated circuit.....	4012-10124
21A41 UE4	Integrated circuit.....	4012-10102
21A41 UF2	Integrated circuit.....	4012-74SL90
21A41 Y1	Crystal, specify frequency	
21A41 Y2	Crystal, specify frequency	
21A41 Y3	Crystal, specify frequency	

Diagrams

21.600 **CONTENTS**

21A11 Frame.....page
21A21 Rear Panel.....
21A22 Regulator..... 21-603
21A31 Front Panel..... 21-605
21A41 Clock Source..... 21-607

PARTS VALUES

Unless noted otherwise

C in μF

L in μH

R in Ω

· special, see parts list

For full type numbers of ICs and transistors, see parts list

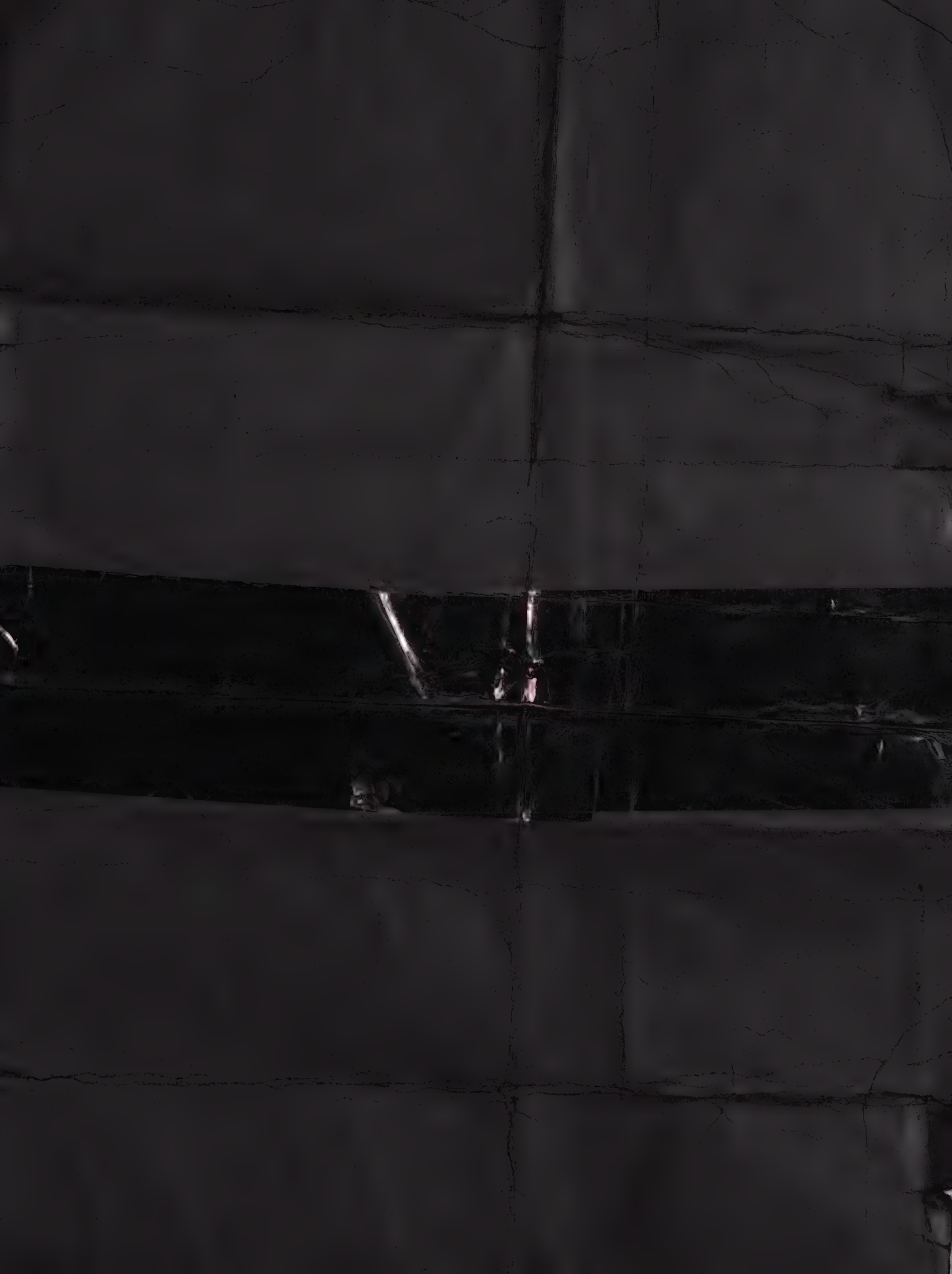
REFERENCE DESIGNATIONS

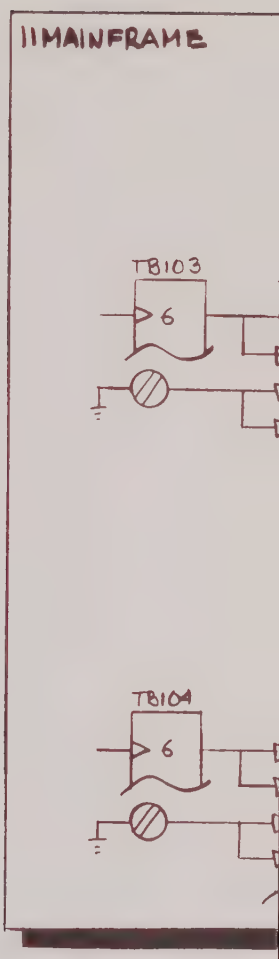
Full reference designations include assembly prefix

SIGNAL ORIGIN

▷— input

▷ output




MAINFRAME
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TB104
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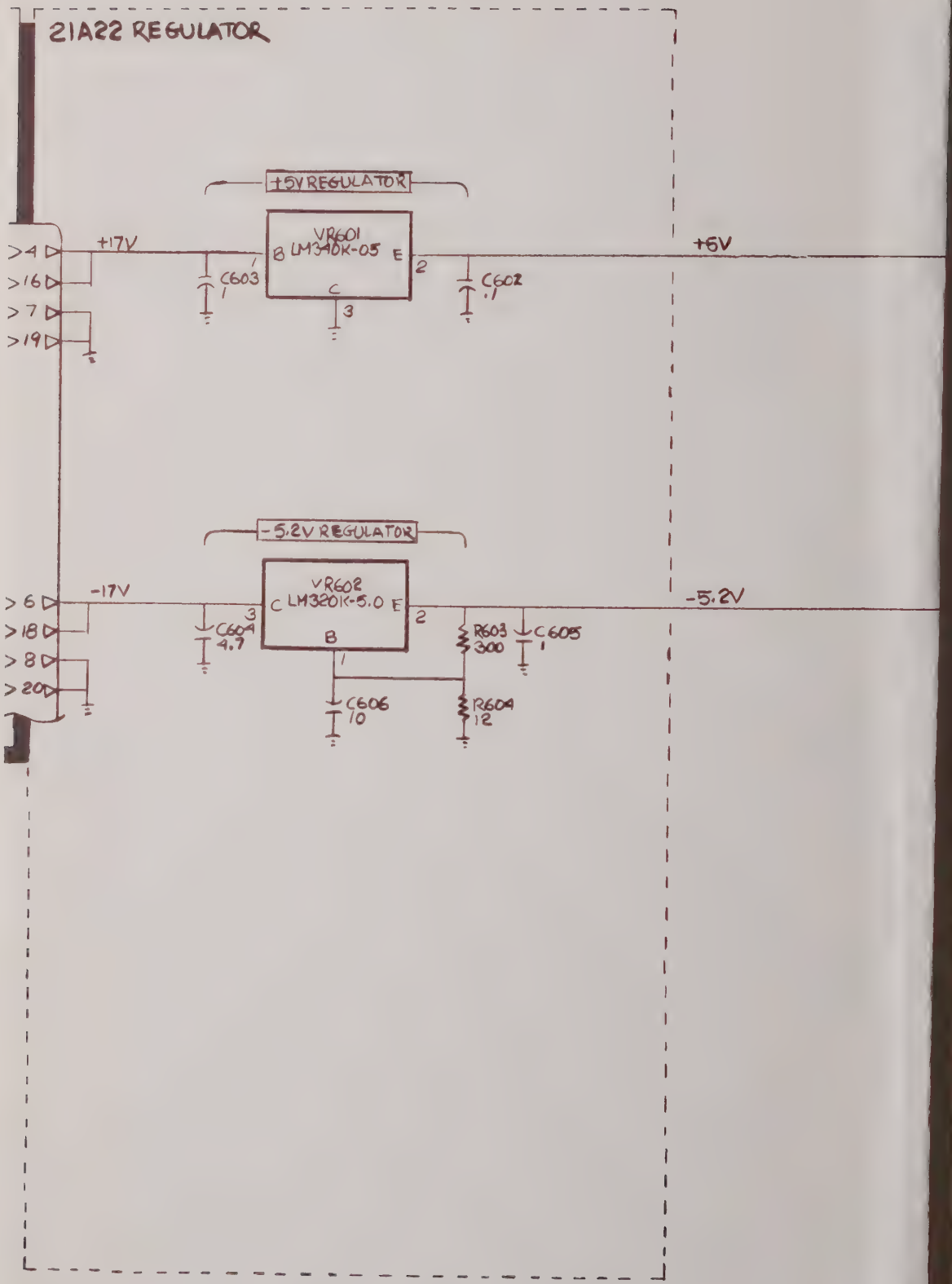
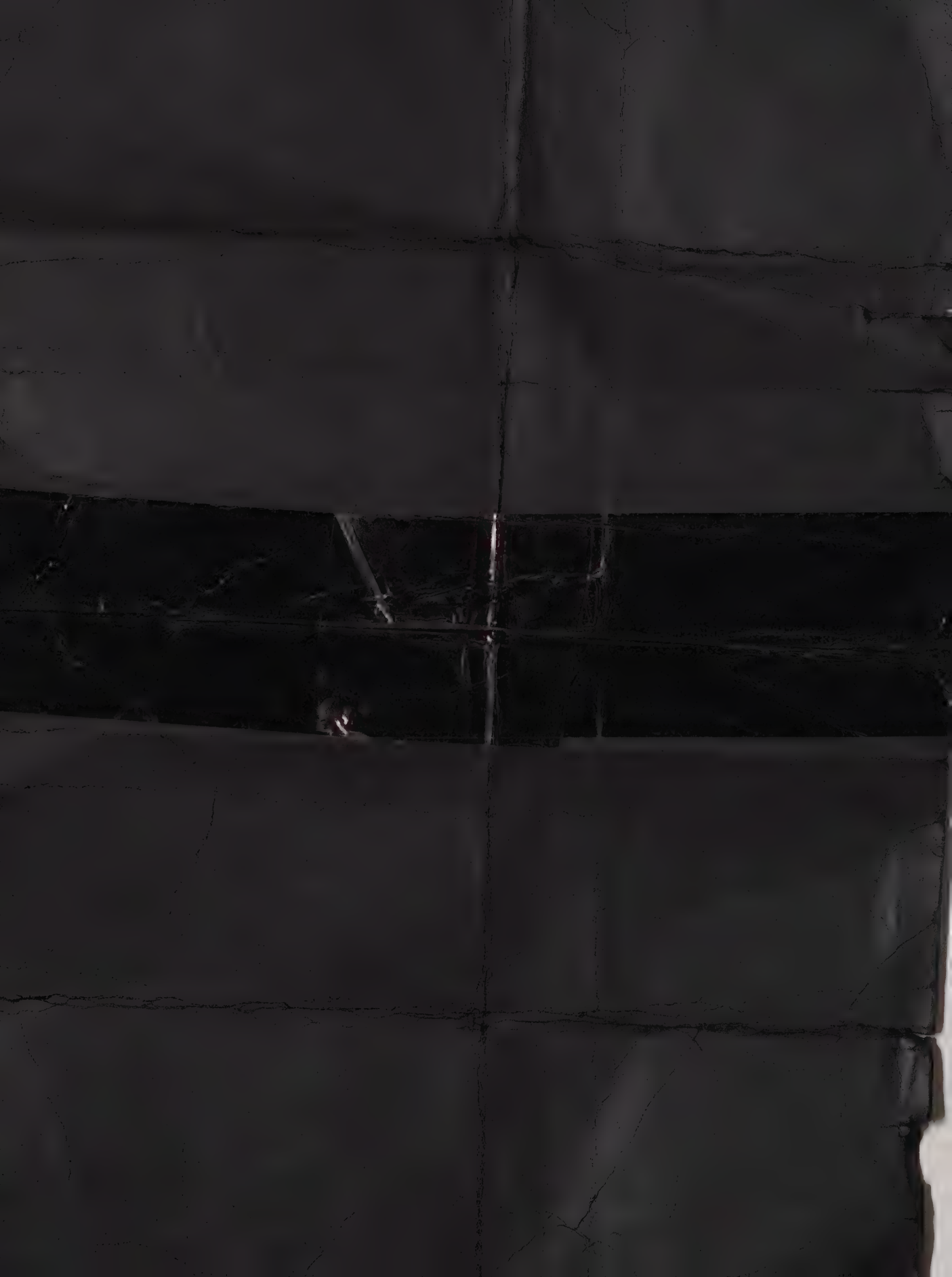
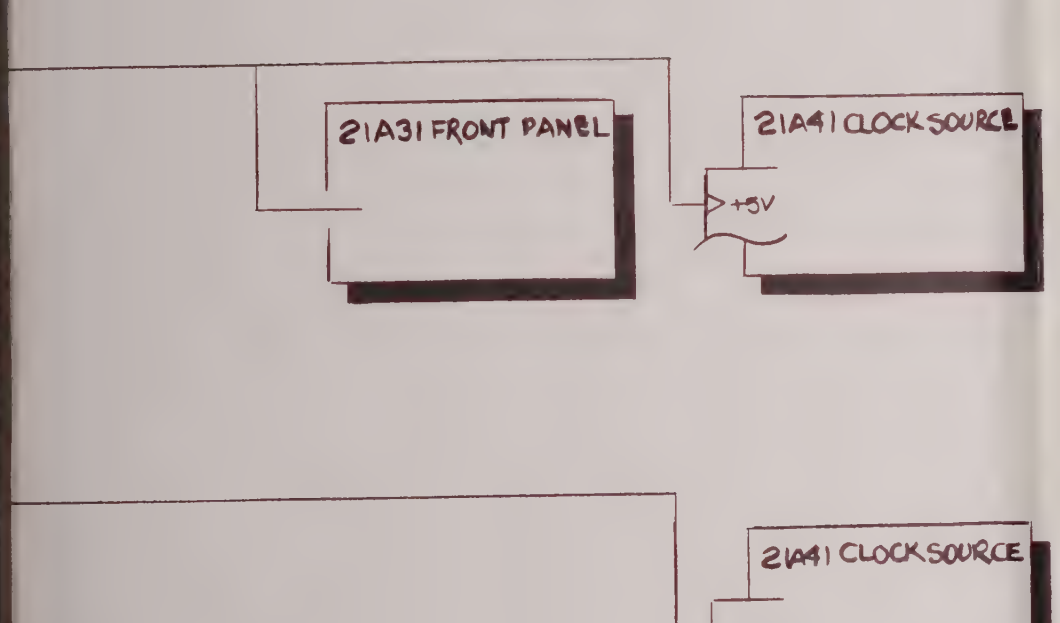

21A22 REGULATOR
+5V REGULATOR
VR601
LM340K-05
B
E
C
+17V
+5V
C603
1
C602
.1
>4
>16
>7
>19
-5.2V REGULATOR
VR602
LM320K-5.0
C
E
B
-17V
-5.2V
C604
4.7
R603
300
C605
1
C606
10
R604
12
>6
>18
>8
>20

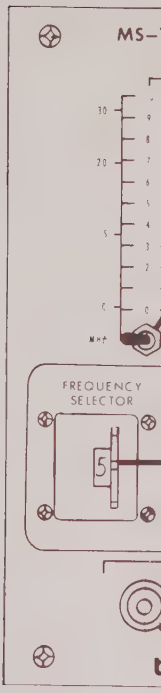




TAJ-53382

Form 0153-0781C3-0781
TAU-TRON TRON
MS-101 IS-101
1 of 1 21A22 A31
REGULATOR ANEL

21-603 I-605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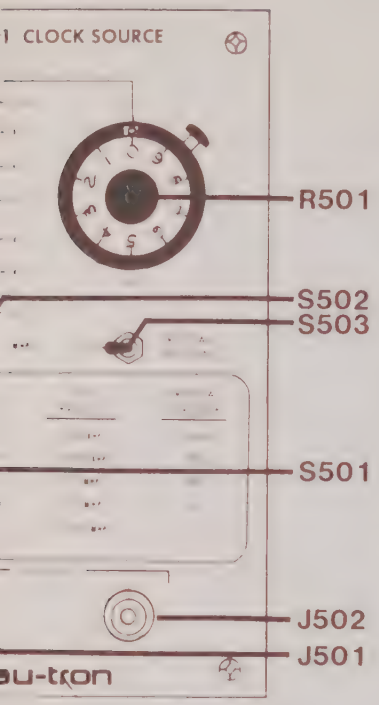
SELECTOR
5



PARTS VALUES

Unless noted otherwise
C in μF
L in μH
R in Ω
· special, see parts list

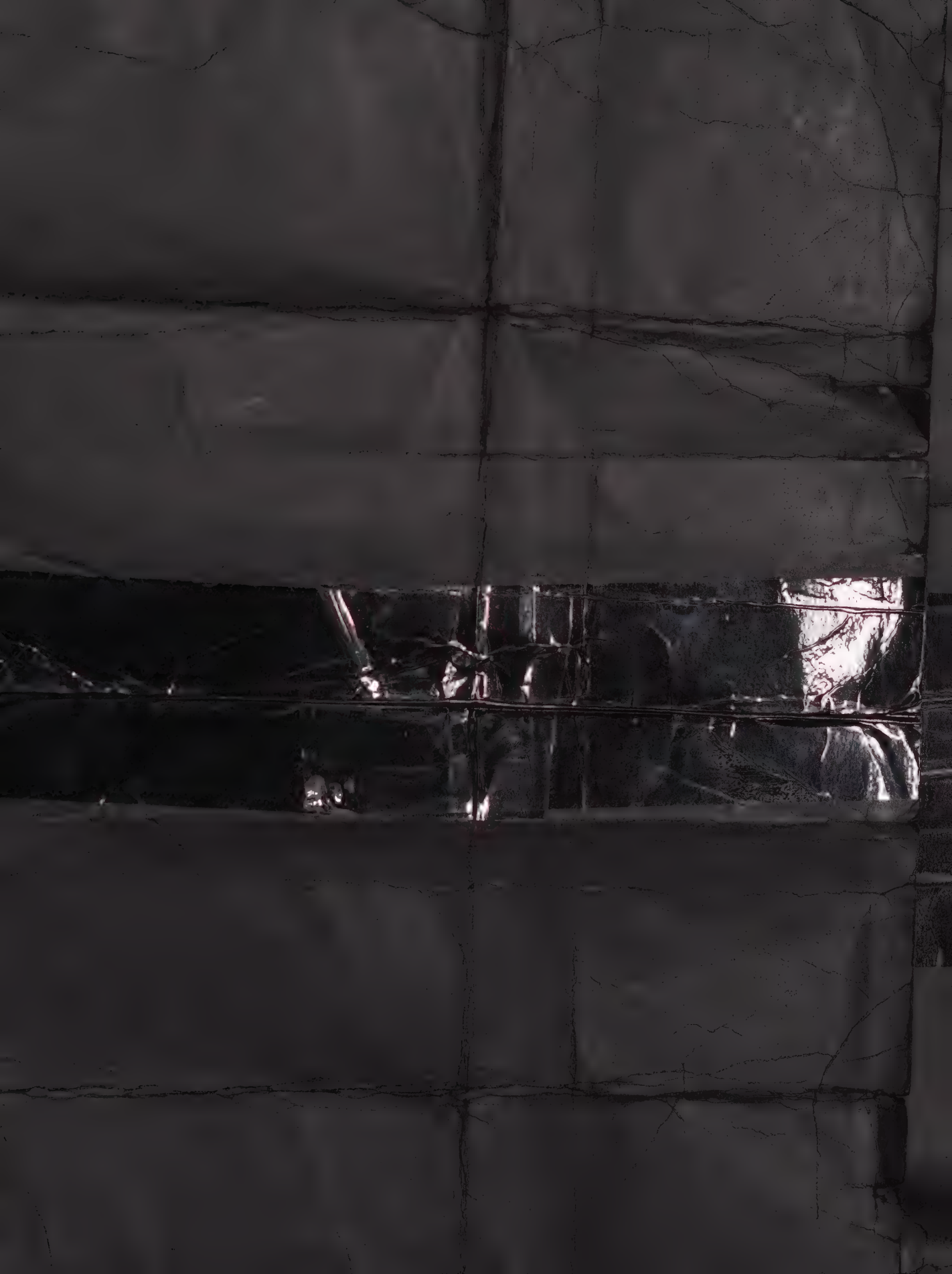
For full type numbers of ICs and transistors, see parts list

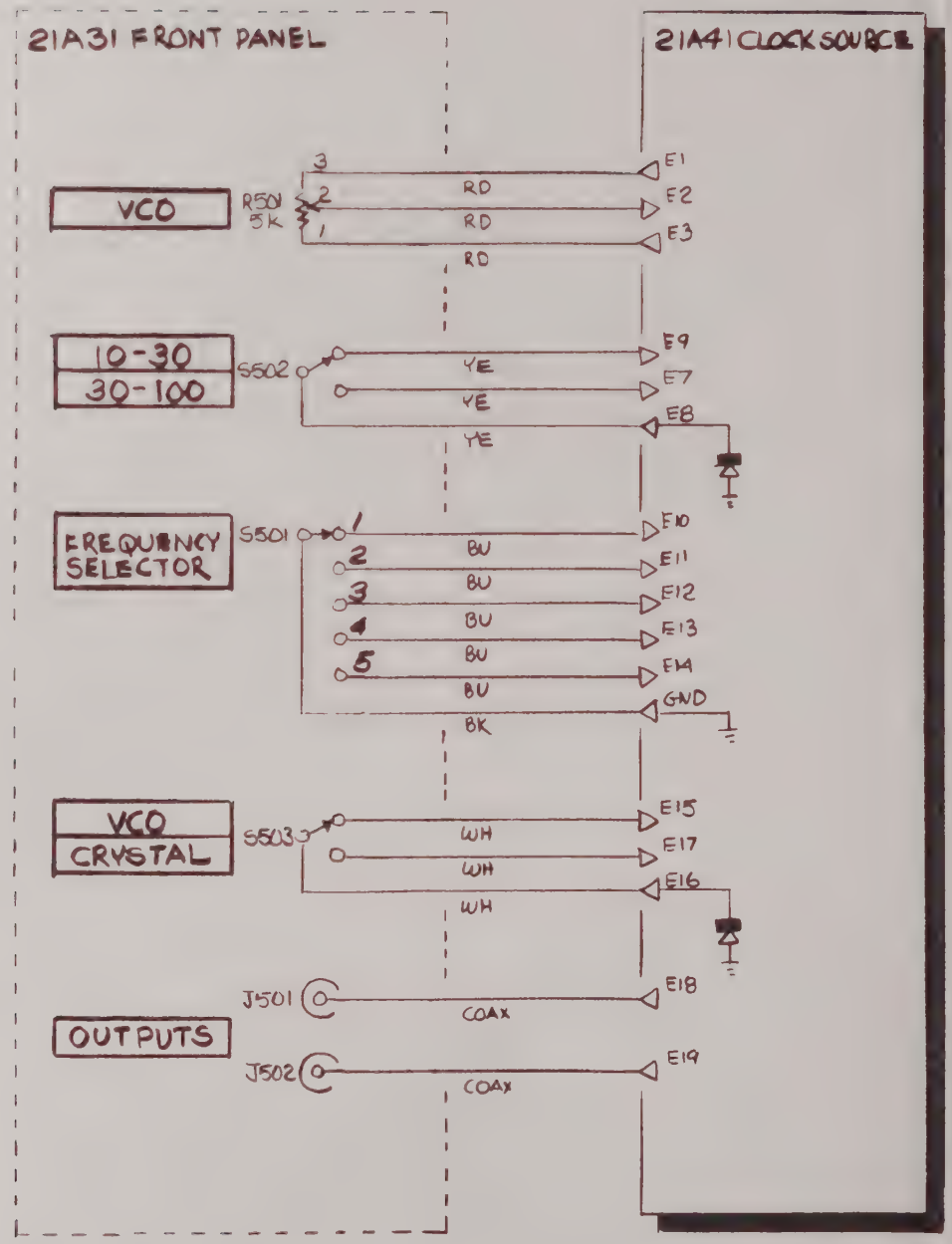
REFERENCE DESIGNATIONS

Full reference designations include assembly prefix

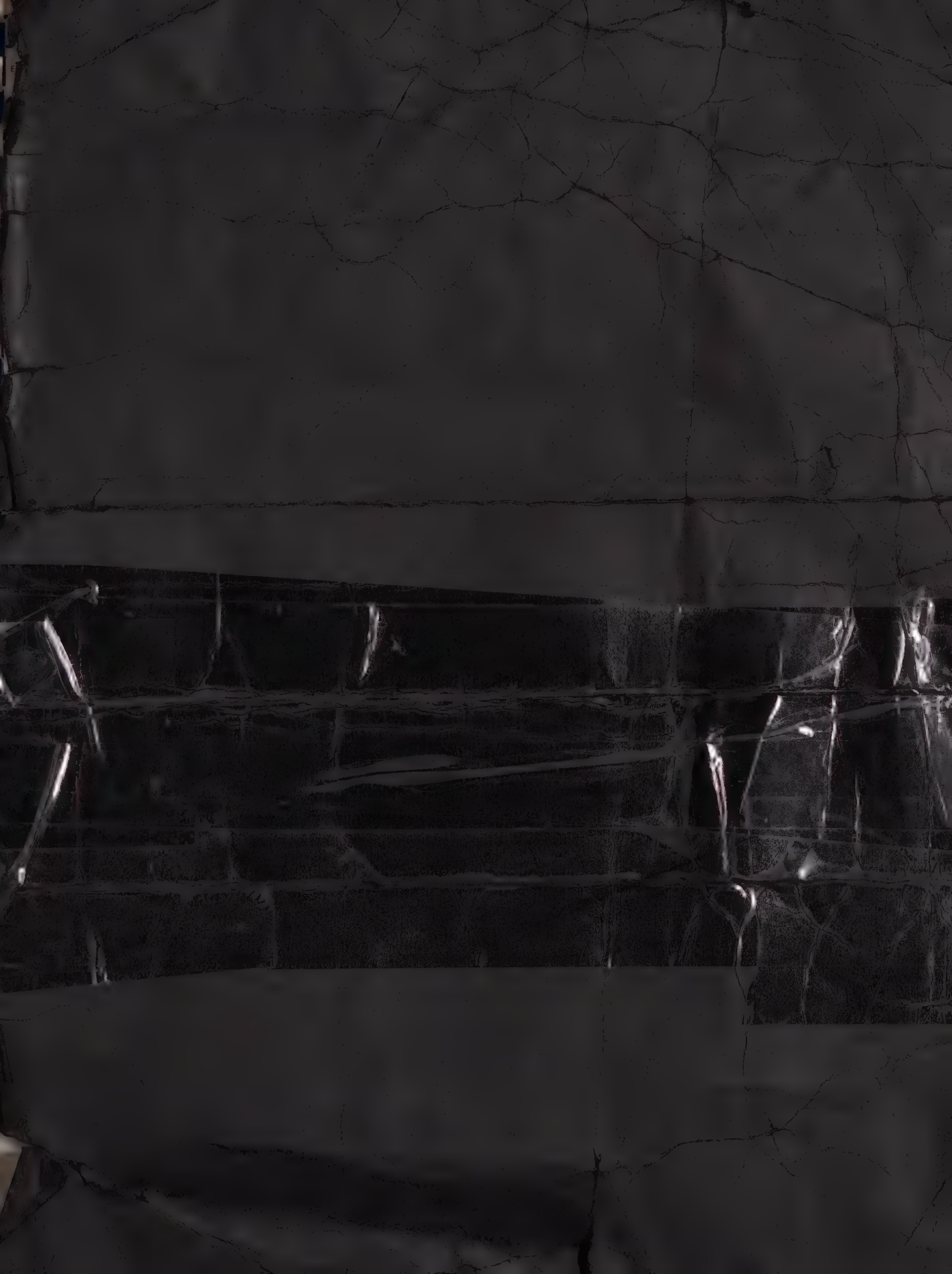
SIGNAL ORIGIN

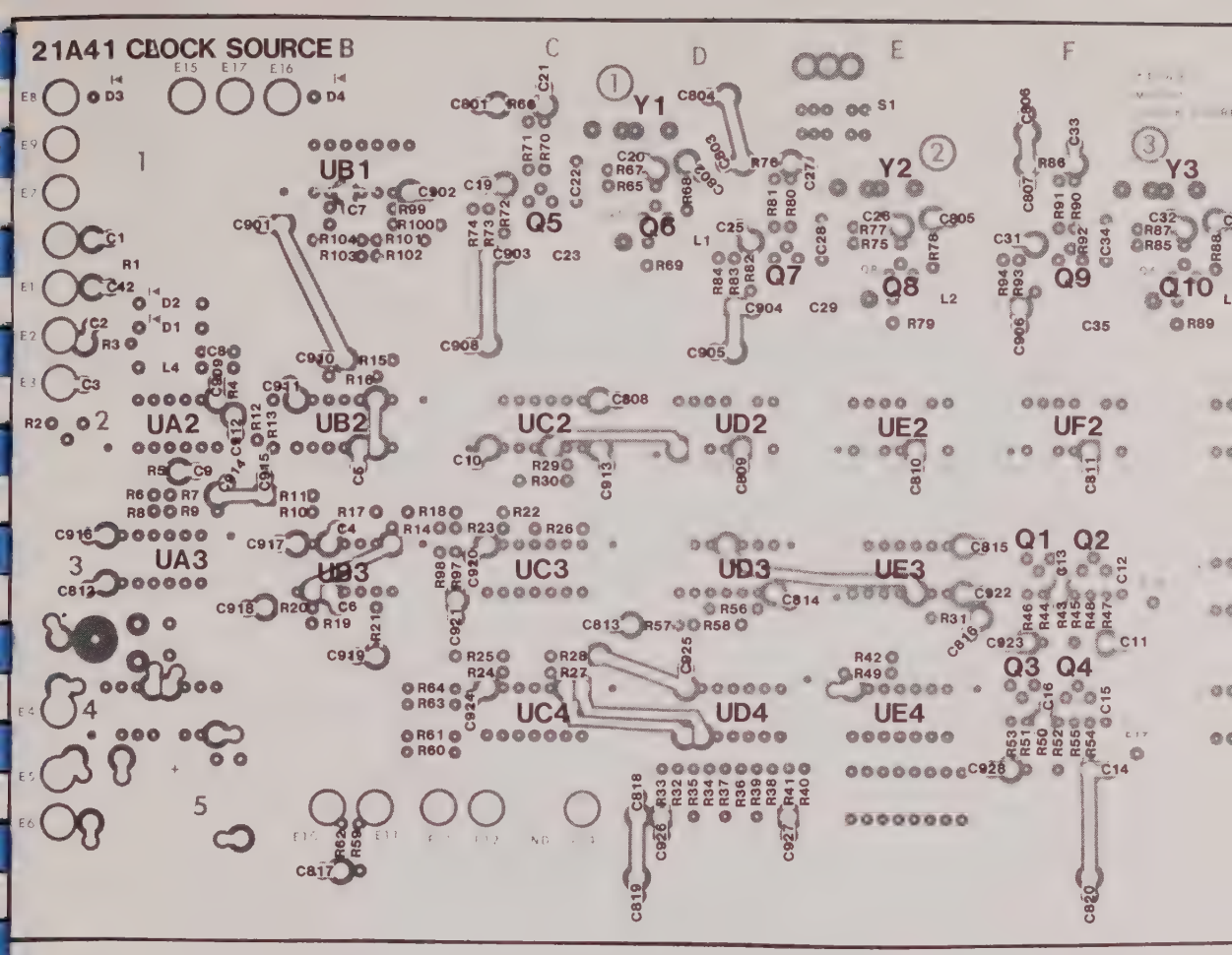
→ input
→ output





Form 0153-0781C
TAU-TRON
MS-101
1 of 1 **21A31**
FRONT PANEL




21A41 CLOCK SOURCE B
UA1
UB1
UC1
UD1
UE1
UF1
UA2
UB2
UC2
UD2
UE2
UF2
UA3
UB3
UC3
UD3
UE3
UF3
UA4
UB4
UC4
UD4
UE4
UF4
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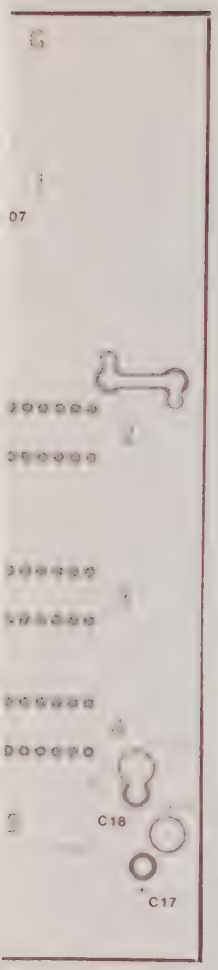
Q7
Q8
Q9
Q10
S1



PARTS VALUES

Unless noted otherwise

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L in μH
R in Ω
· special, see parts list

For full type numbers of ICs and transistors, see parts list

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Full reference designations include assembly prefix

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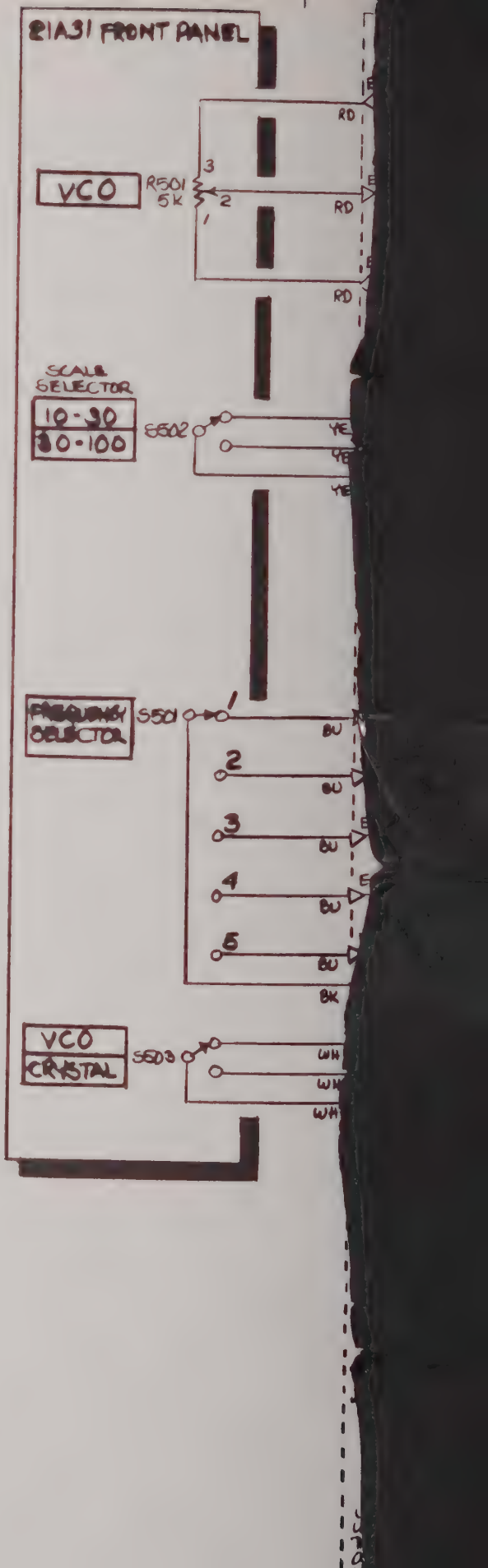
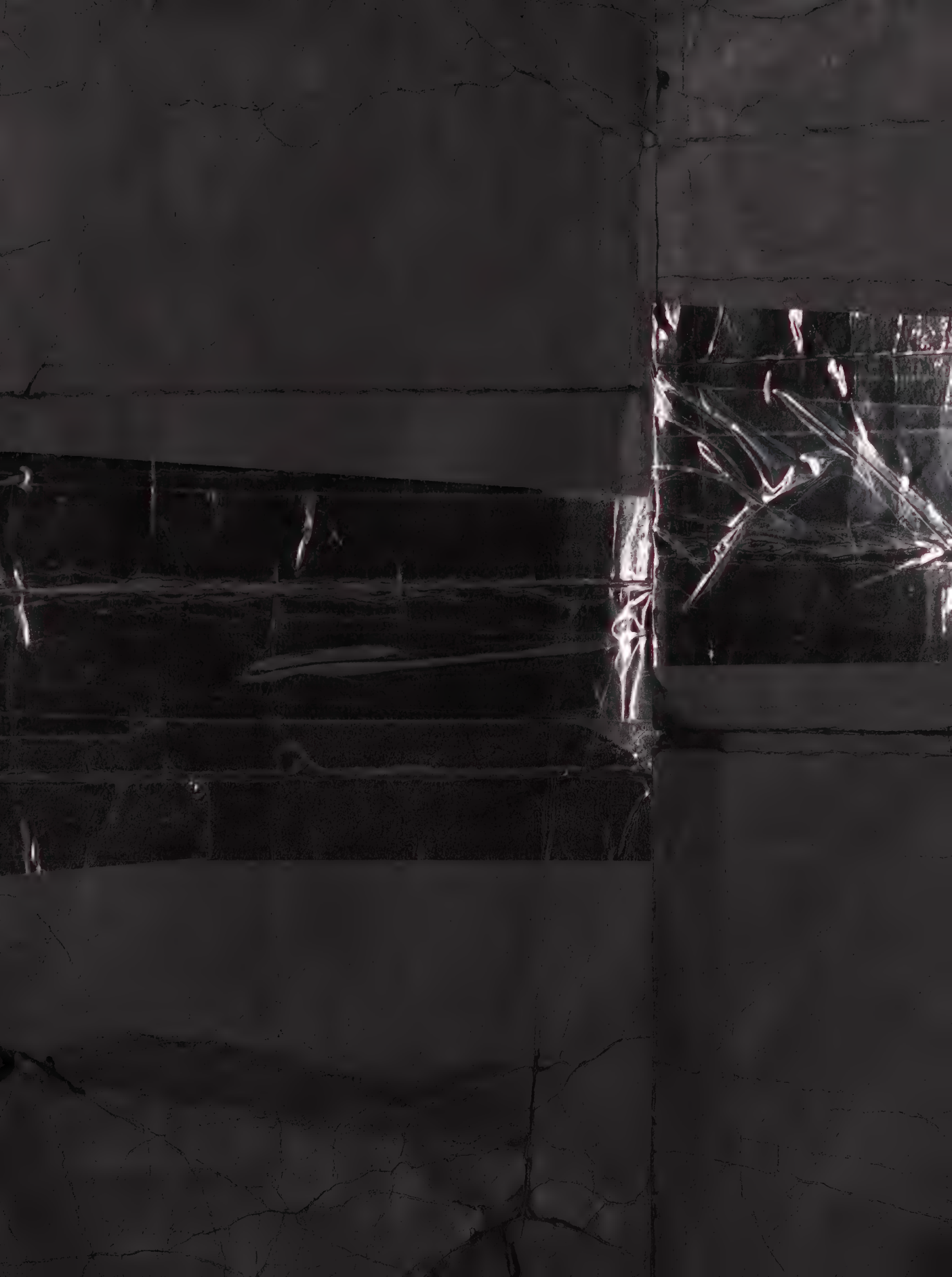
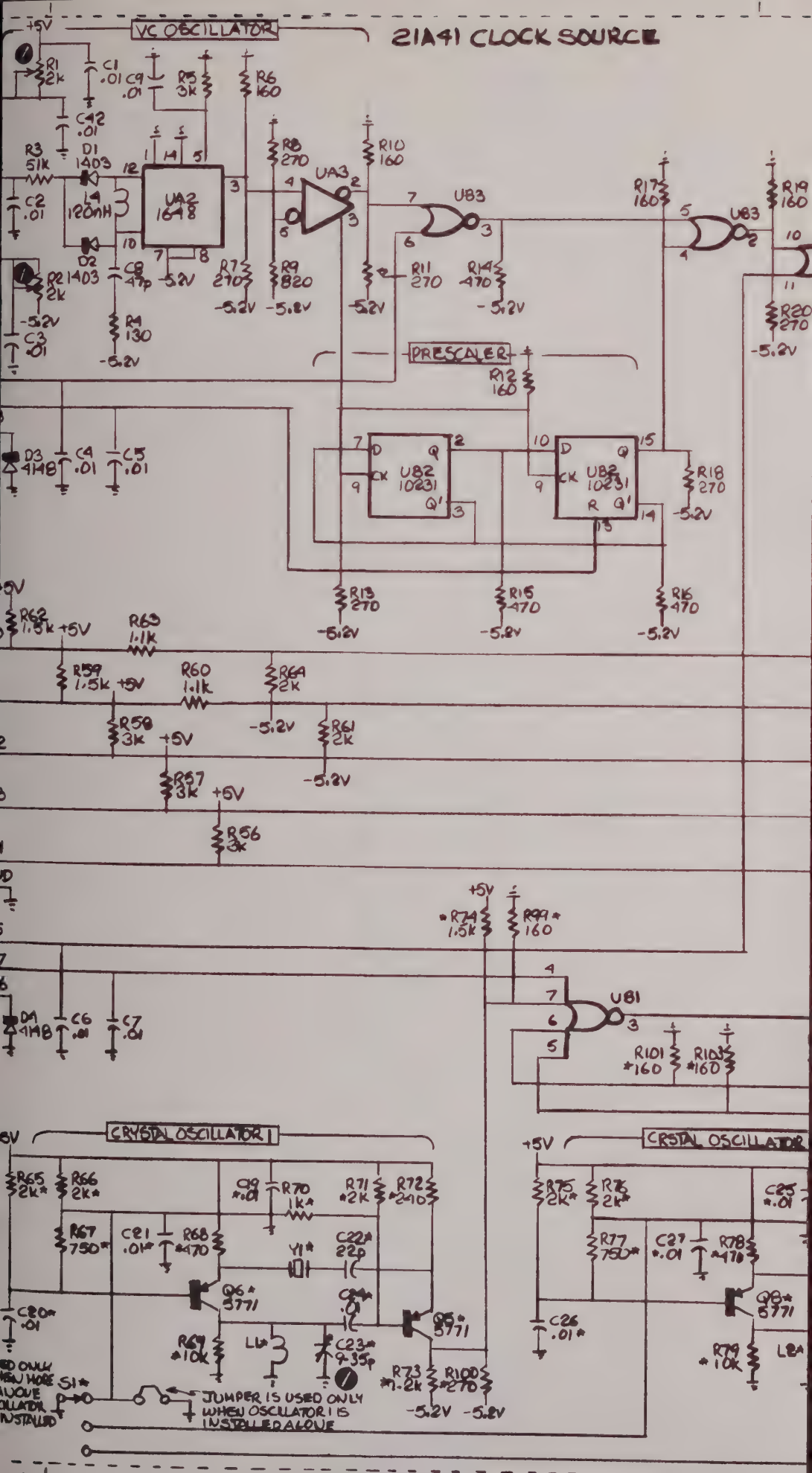
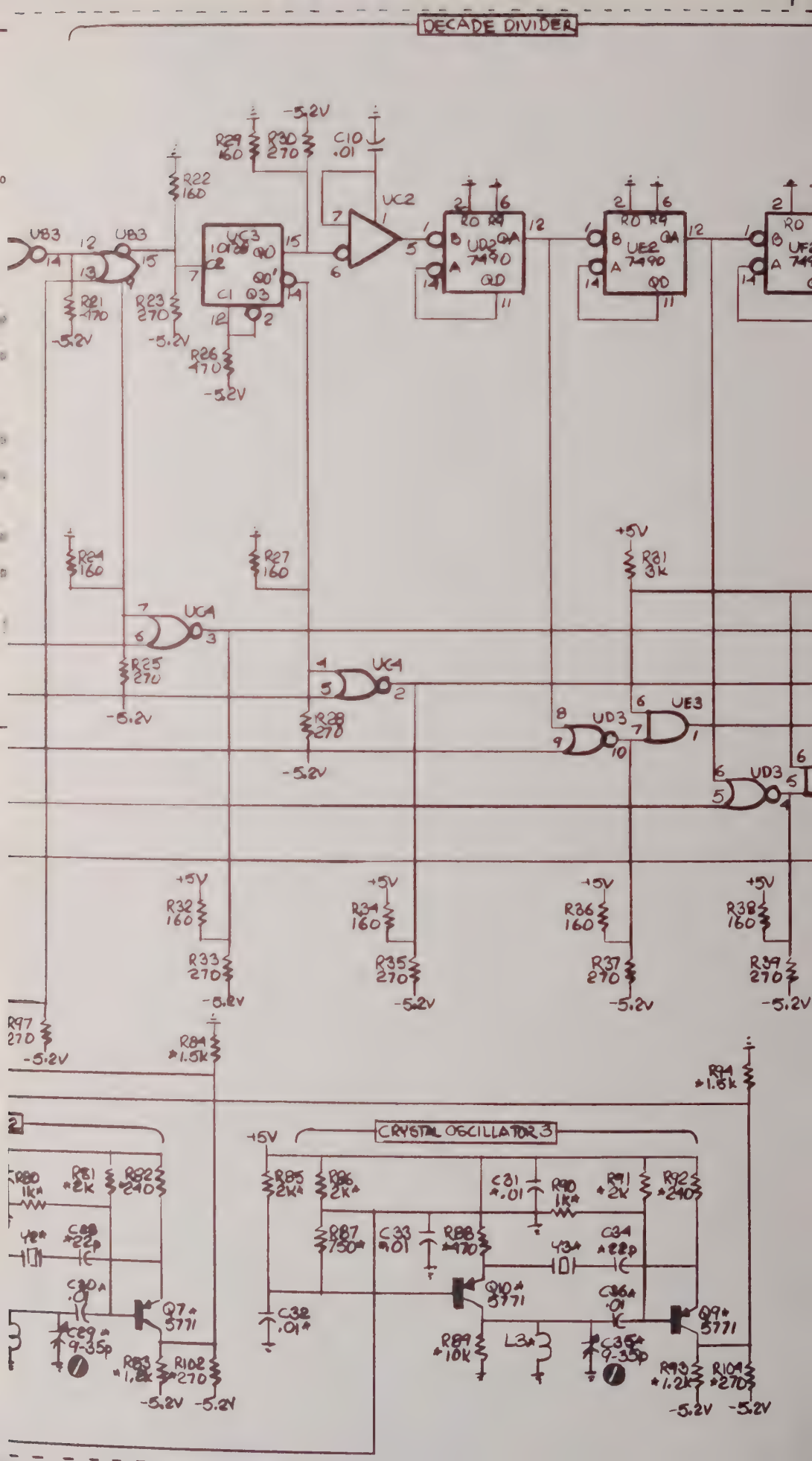
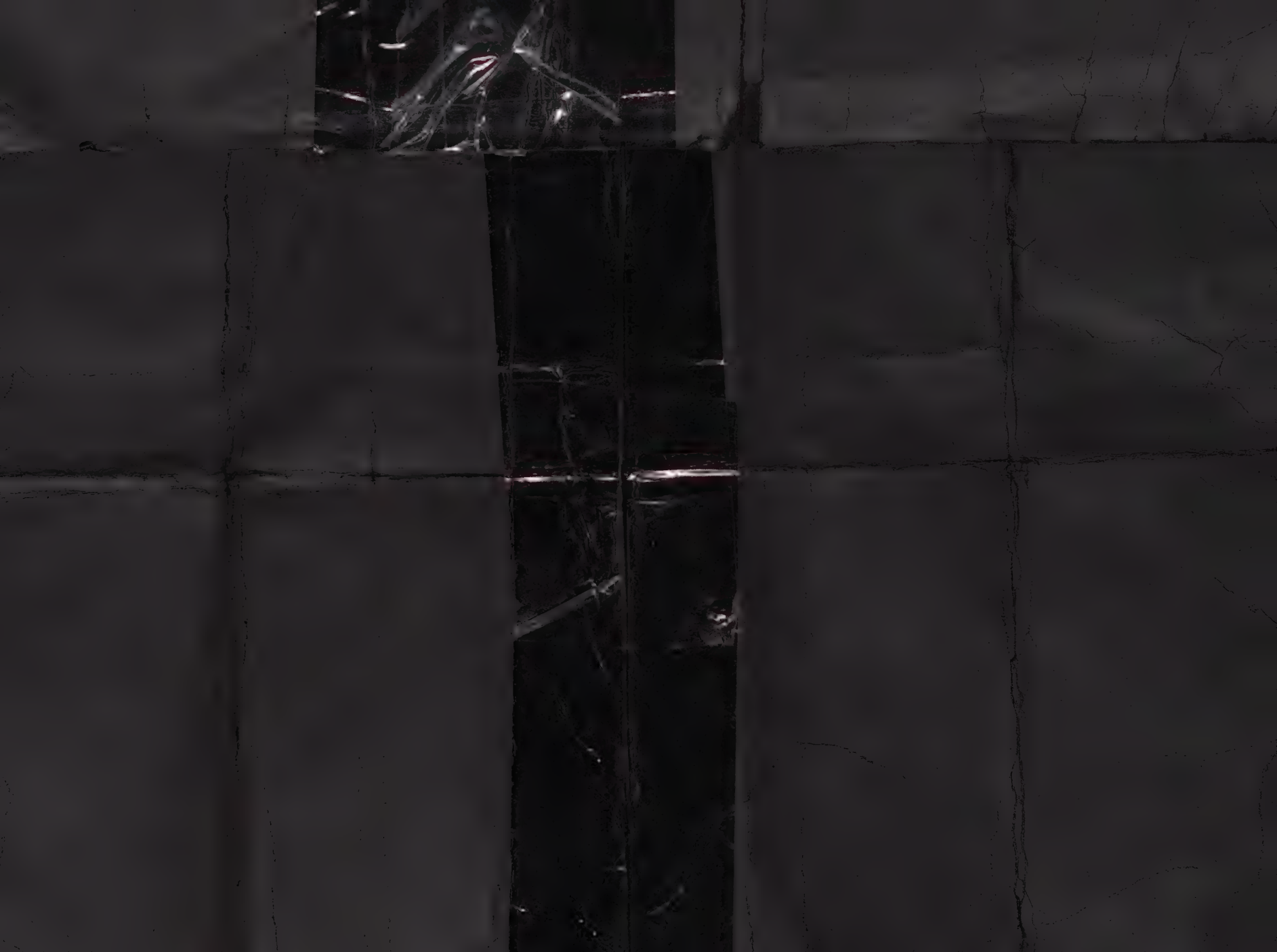
→ input
↔ output

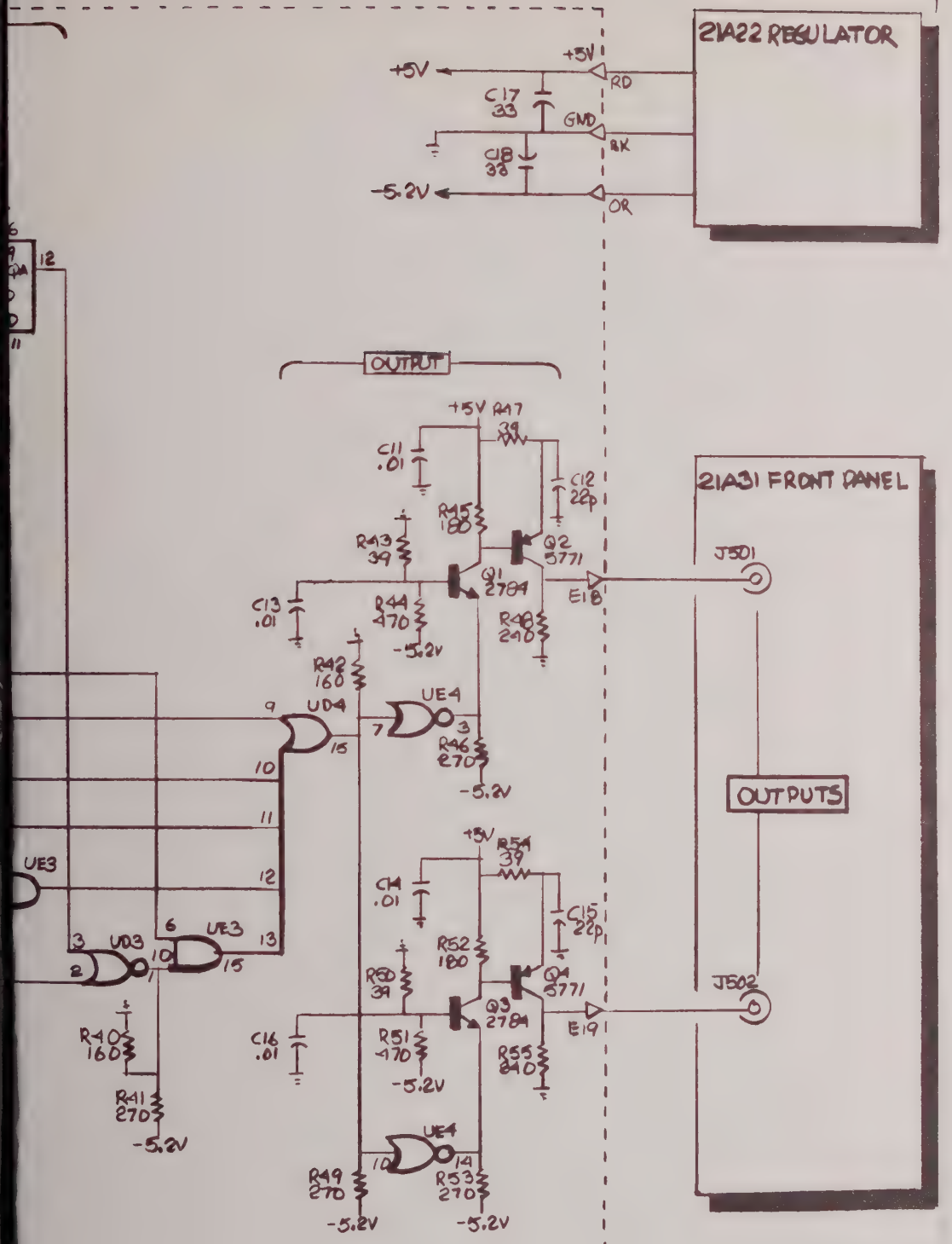





21A41 CLOCK SOURCE
VC OSCILLATOR
PRESCALER
CRYSTAL OSCILLATOR 1
CRSTAL OSCILLATOR
UA2 1648
UA3
UB3
UB2 10231
UB1
JUMPER IS USED ONLY WHEN OSCILLATOR 1 IS INSTALLED ALONE


DECADE DIVIDER
CRYSTAL OSCILLATOR 3
UB3
UC3
UC2
UD2
7490
UE2
7490
UC4
UD3
UE3
R29 160
R30 270
C10 .01
R22 160
R21 470
R23 270
R26 470
R24 160
R27 160
R25 270
R28 270
R31 3k
R32 160
R33 270
R34 160
R35 270
R36 160
R37 270
R38 160
R39 270
R97 270
R84 *1.5k
R94 *1.5k
R80 1k*
R81 *2k
R82 *240
Y2*
C28 *22p
C30 .01
C29 9-35p
Q7* 5771
R83 *1.2k
R102 270
R85 2k*
R86 2k*
R87 750*
C33 *.01
R88 *470
C31 *.01
R90 1k*
R91 *2k
R92 *240
Y3*
C34 *22p
Q10* 5771
C32 .01*
C36* .01
Q9* 5771
R89 *10k
L3*
C35* 9-35p
R93 *1.2k
R104 *270
-5.2V
+5V





TDJ-54093
REV C

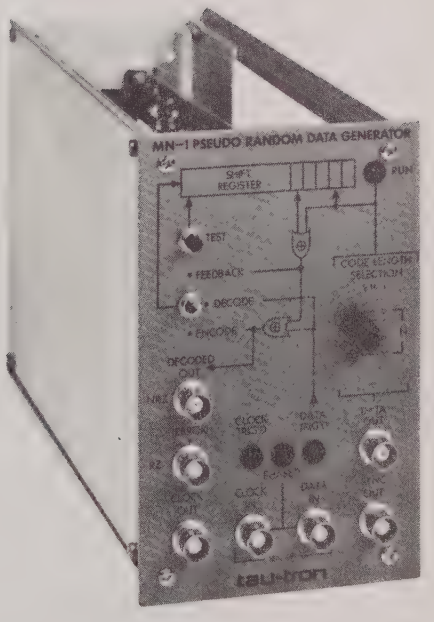
Form 0153-0781C
TAU-TRON
MS-101

1 of 1 **21A41**
CLOCK SOURCE

Changes

21.700 **CONTENTS**

Where not contained in the body of the manual, information on options, variations, and modifications is contained in this section.



CONFIGURATION

Your unit is **serial number** _____
and is configured as follows (information on these differences is contained in the body of the manual and/or in the rear of the manual under Changes):

__ OP-01A ECL into 50Ω to -2V
__ OP-01B ECL into 50Ω to gnd
__ OP-01C ECL into 100Ω to -2V
__ OP-01D ECL into 100Ω to gnd
__ OP-01E ECL into 50Ω to gnd

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MN-1

PSEUDORANDOM DATA GENERATOR

INSTRUCTION MANUAL

Form 0154-0681C

Copyright 1981 by Tau-Tron Inc., 27 Industrial Ave., Chelmsford, MA 01824
(617) 256-9013 Telex 951952

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31.108 Power..... 31-103
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31.101 SCOPE

This instruction manual provides operation and maintenance information for the Tau-Tron MN-1 Pseudo Random Data Generator, including all serial numbers, options, variations, and modifications.

31.102 DESCRIPTION

The Tau-Tron MN-1 Pseudo Random Data Generator is a quarter-size Tau-Tron Modular Instrument that generates pseurodandom patterns, with a choice of six code lengths, when driven by an external source from 1Hz to 75MHz.

31.103 SPECIFICATIONS

Clock Input	1Hz to 75MHz, 5ns min width, 2±0.3V into 50Ω to ground with baseline of 0±0.2V, applied at front-panel BNC connector. Other levels available, see Option 01.
Data Input	1b/s to 75Mb/s, NRZ format, 2±0.3V into 50Ω ground with baseline of 0±0.2V, applied at front-panel BNC connector; other levels available, see Option 01.
Data Patterns	Pseudorandom with choice of 6 front-panel selected lengths of 2^6-1(63), 2^9-1 (511), 2^{11}-1 (2047), 2^{15}-1 (32,767), 2^{17}-1 (131,071), or 2^{20}-1 (1,048,576) bits.
Data Output	NRZ format with choice of 3 front-panel selected outputs of: the selected pseudorandom word length (feedback mode), encoded data (encode mode), or identical to input data (decode mode); 2±0.3V with baseline of 0±0.2V into 50Ω to ground at front-panel BNC connector. Other levels available, see Option 01.
Clock Output	5ns min width pulses, 2±0.3V with baseline of 0±0.2V into 50Ω to ground at front-panel BNC connector. Other levels available, see Option 01.
NRZ Decoded Output	NRZ format, 5ns min pulse width, with output dependent on mode as: selected pseudorandom word length exclusively or'ed with data input (feedback mode), encoded data (encode mode), or decoded data (decode mode); 2±0.3V with baseline of 0±0.2V into 50Ω to ground at front-panel BNC connector. Other levels available, see Option 01.

RZ Decoded Output	RZ format, 5ns min pulse width, with output dependent on mode as: selected pseudorandom word length exclusively or'ed with data input (feedback mode), encoded data (encode mode), or decoded data decode mode); 2±0.3V with baseline of 0±0.2V into 50Ω to ground at front-panel BNC connector. Other levels available, see Option 01.
Sync Output	One clock-period-wide pulse occuring once every pseudorandom sequence; 2±0.3V with baseline of 0±0.2V into 50Ω to ground at front-panel BNC connector. Other levels available, see Option 01.
Power	+17V nominal at 0.3A, -17V nominal at 1.2A, both unregulated and both supplied by mainframe.
Cooling	Forced air, supplied by mainframe.
Mechanical	TMI quarter-size module. DIMENSIONS: 6.375 in. high X 4 in. wide X 11 in. deep. WEIGHT: 3 lb net, 5 lb shipping.
Special Levels Option 01	Input and output levels other than standard TMI 2V into 50Ω to ground are available. Such levels include TTL with 50Ω to ground and ECL with 50 or 100Ω to ground or to -2V.

31.104 WARRANTY

All Tau-Tron products are warranted against any defects in material and workmanship. This warranty applies for one year from the date of delivery for all Tau-Tron manufactured products. The warranty period for OEM products sold by Tau-Tron will depend on the original OEM warranty (consult factory for specific products). We will repair or replace products which, upon our examination, prove to be defective during the warranty period.

NO OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING FITNESS FOR PURPOSE, MERCHANTABILITY OR OTHERWISE, IS GIVEN.

For any assistance, contact Customer Service with details of the instrument model, serial numbers, and malfunction, see Repair Returns below.

31.105 SHIPPING DAMAGE

If any signs of damage are noted on the outside of the carton, request the carrier's agent to be present during unpacking. If external damage is found on the instrument follow Repair Returns procedure below.

Check out the electrical performance of the instrument as soon as possible after receipt. If any malfunctions are observed, follow Repair Return procedure below.

31.106 REPAIR RETURNS

For mechanical damage or electrical malfunctions, notify Tau-Tron immediately and if the damage occurred during shipping, also notify the carrier. To return a unit for repair:

1. Call the Customer Service Dept., (617)256-9013, for a Repair Authorization Number. This will reduce administrative delays and ensure prompt return of your unit.
2. Complete and attach the Repair Tag, in the rear of the manual, to your unit for positive identification.

3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb) and shock absorbing material such as bubblewrap to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.

4. Send to: Tau-Tron
27 Industrial Ave.
Chelmsford, MA 01824
Attn: Customer Service

31.107 ASSISTANCE

For service assistance call the Tau-Tron Customer Service Dept., (617)256-9013. Their experience and expertise can often save you valuable time in correcting any equipment malfunction.

31.108 POWER

CAUTION Be sure the line switch on the rear panel of the mainframe is set to the proper range (115 or 230V) before connecting to the ac line. If the incorrect range is selected, the instrument could be damaged.

All power for the module is supplied by the mainframe upon insertion of the module.

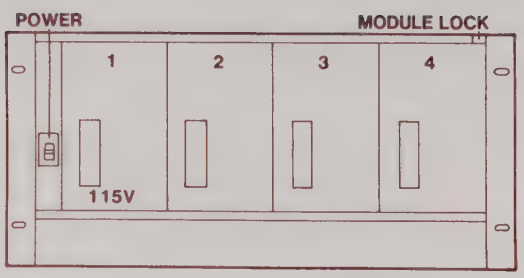
31.109 SITE REQUIREMENTS

Power	All power is supplied by the mainframe which requires 90 to 135V or 180 to 270V, 50 to 60 Hz ac.
Temperature	32 to 113°F (0 to 45°C).
Humidity	0 to 95% RH, max at 20°C, non-condensing.
Clearances	Cooling is supplied by the mainframe. The only clearances required by the module are those necessary for access to the front-panel operating controls.

31.110 **INSTALLATION**

Module Insertion

1. Pull out the Module Lock knob.
2. Insert the Module as required.
3. Push in the Module Lock knob.



The module(s) can be inserted in any position desired except any user-built module that requires ac power must connect to the position-1 connector. In general, systems shipped by Tau-Tron have modules inserted in the following order:

Position 1...Clock
Position 2...Transmitter
Position 3...Receiver

Module Removal

1. Pull out the Module Lock knob.
2. Grasp the module to be removed by its front-panel BNC connector(s) and pull to remove.
3. Push in the Module Lock knob to prevent the remaining modules from accidently falling out.

Interconnections

The CLOCK IN of the MN-1 normally connects to the output of a clock by means of a BNC terminated cable of the shortest practical length.

The CLOCK OUT and DATA OUT of the MN-1 normally connects to the system under test.

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31.203 Input/Output Timing. 31-204
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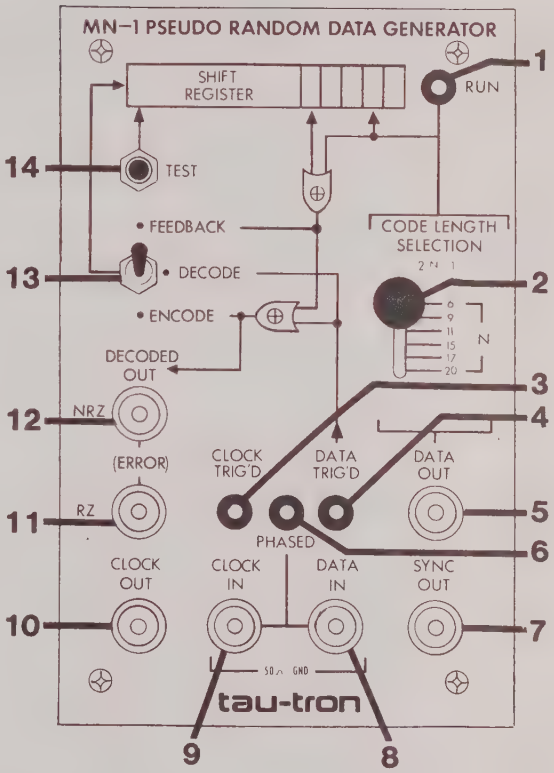
31.208 Error Detection..... 31-207

31.201 FRONT PANEL



1 RUN — Light-emitting diode indicates the pseudorandom generator is operating.

2 CODE LENGTH — Six-position slide switch controls the length of the pseudorandom word as 2^6-1 (63), 2^9-1 (511), 2^{11}-1 (2047), 2^{15}-1 (32,767), 2^{17}-1 (131,071), or 2^{20}-1 (1,048,576) bits.

3 CLOCK TRIG'D — Light-emitting diode indicates an active signal is present at the CLOCK IN connector.

4 DATA TRIG'D — Light-emitting diode indicates an active signal is present at the DATA IN connector.

5 DATA OUT — BNC connector for NRZ format output data at a standard TMI level of 2±0.3V into 50Ω to ground. The output depends on the setting of the Mode control, whether or not the TEST button is pushed, and whether or not data in is present, see paragraph 31.202.

6 PHASED — Light-emitting diode indicates the clock and data signals at the CLOCK IN and DATA IN connectors are properly aligned, see paragraph 31.204 for details.

7 SYNC OUT — BNC connector for one- clock-period-wide pulse occuring once every pseudorandom sequence at a standard TMI level of 2±0.3V into 50Ω to ground. It occurs when the shift register contains a logic-1 in the first bit position and logic-0s in the other bit positions.

The sync output is normally used to synchronize an oscilloscope, error-injection circuit, or other such instrumentation.

8 DATA IN — BNC connector for NRZ format data at a standard TMI level of 2±0.3V into 50Ω to ground.

The data input is normally connected to the data output of another data generator for data scrambling or to the data output of the system under test for data unscrambling and error detection.

9 CLOCK IN — BNC connector for input clock signal at a standard TMI level of 2±0.3V into 50Ω to ground.

The clock input is normally connected to the output of a clock source such as an MS-101. The clock input is used in all four basic operating configurations of the MN-1.

10 CLOCK OUT — BNC connector for 5ns min width pulse at a standard TMI level of 2±0.3V into 50Ω ground. It is a fixed-width pulse at the input clock frequency.

The clock out is normally connected to the system under test for data generation and data scrambling.

11 RZ DECODED OUT — BNC connector for RZ format output at a standard TMI level of 2±0.3V into 50Ω to ground. It occurs ahead of the DATA OUT by the number of bits (N) set by the CODE LENGTH control. The output depends on the setting of the Mode control, whether or not the TEST button is pushed, and whether or not data in is present (see paragraph 31.202).

The RZ decoded output is normally connected to a counter and is used in error detection to count bit errors.

12 NRZ DECODED OUT — BNC connector for NRZ format output at a standard TMI level of 2±0.3V into 50Ω ground. It occurs ahead of the DATA OUT by the number of bits (N) set by the CODE LENGTH control. The output depends on the setting of the Mode control, whether or not the TEST button is pushed, and whether or not data in is present (see paragraph 31.202).

The NRZ decoded output is normally used to monitor unscrambled data on an external oscilloscope.

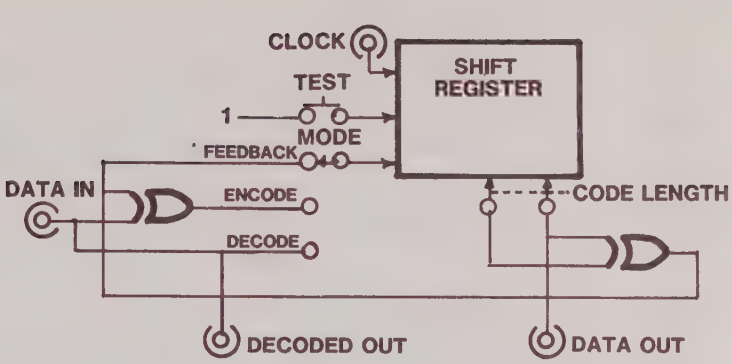
13 Mode — Three-position toggle switch controls the output of the three data outputs. These outputs also depend on whether or not the TEST button is pushed and whether or not data in is present (see paragraph 31.202).

The Mode control is normally set to FEEDBACK for data generation, ENCODE for data scrambling, and DECODE for data unscrambling and error detection.

14 TEST — Momentary pushbutton forces the pseudorandom generator to all-ones state. The output of the three data outputs also depends on the setting of the Mode control and whether or not data in is present (see paragraph 31,202).

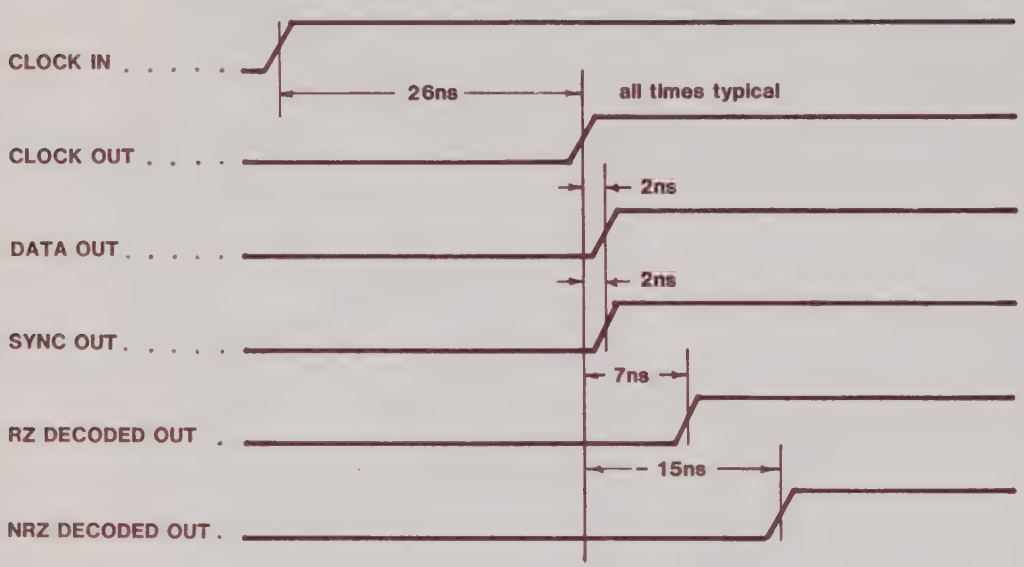
31.202 **DATA OUTPUTS**

The outputs from the three data output connectors (DATA OUT, NRZ DECODED OUT, and RX DECODED OUT) depend on the setting of the Mode control, whether or not the TEST button is pushed, and whether or not a signal is present at the DATA IN connector, as follows:



MODE	TEST	DATA OUT	NRZ DECODED OUT	RZ DECODED OUT
WITH NO DATA IN:				
FEEDBACK	Not pushed	NRZ format pseudorandom word.	NRZ format pseudorandom word.	RZ format pseudorandom word.
	Pushed	High level.	Low level.	Low level.
DECODE	Not pushed	Low level. (no signal).	Low level. (no signal).	Low level. (no signal).
	Pushed	High level.	Low level.	Low level.
ENCODE	Not pushed	NRZ format pseudorandom word.	NRZ format pseudorandom word.	RZ format pseudorandom word.
	Pushed	High level.	Low level.	Low level.
WITH DATA IN:				
FEEDBACK	Not pushed	NRZ format pseudorandom word.	NRZ format pseudorandom word exclusively or'ed with DATA IN.	RZ format
	Pushed	High level	NRZ format. Follows DATA IN	RZ format.
DECODE	Not pushed	NRZ format. Follows DATA IN	NRZ format. Quotient of DATA IN divided by pseudorandom word.	RZ format.
	Pushed	High level.	NRZ format Follows DATA IN	RX format.
ENCODE	Not pushed	NRZ format. Product of data in multiplied by pseudorandom word.	NRZ format.	RZ format.
	Pushed	High level	NRZ format. Follows DATA IN	RZ format.

31.203 **INPUT/OUTPUT TIMING**



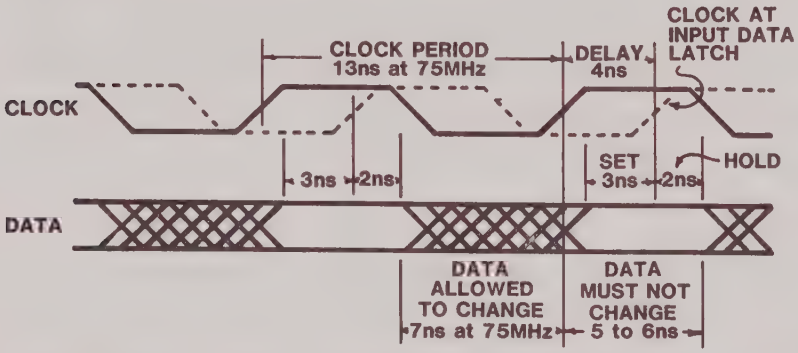
31.204 **PHASING**

Background

Whenever data is applied to the DATA IN connector, such as for:

Data Scrambling, paragraph 31.206
Data Unscrambling, paragraph 31.207
Error Detection, paragraph 31.208

the input data must be properly phased with the clock signal applied to the CLOCK IN connector.



Basically this means the data must not change during the 3ns set time and 2ns hold time of the input data latch. Since the internal path of the clock signal to the latch is typically 4ns longer than that of the data path, this translates to a region some 5 to 6ns after the rising edge of the clock signal, referred to the input connectors, during which the input data must not change. This relationship becomes critical only at the higher frequencies:

DATA CHANGES ALLOWED			DATA CHANGES ALLOWED		
Frequency	Duration	Percent*	Frequency	Duration	Percent*
75 MHz	7ns	54%	7.5 MHz	124ns	95%
50 MHz	14ns	70%	5 MHz	194ns	97%
25 MHz	34ns	85%	2.5 MHz	394ns	99%
10 MHz	94ns	94%	1 MHz	994ns	>99%

* Percent of total clock period data is allowed to change.

Proper Phasing

Proper phasing is indicated by an illuminated PHASED indicator. As a further check, the DATA IN signal and NRZ DECODED OUT signal can be monitored on an oscilloscope; both signals should be the same with the TEST pushbutton depressed.

Improper Phasing

Improper phasing can be remedied by adding cable to the CLOCK IN path to increase the delay slightly; approx. 1.5ns per foot.

31.205 **DATA GENERATION**

The MN-1 normally functions as a pseudorandom generator, which requires the following connections and control settings:

CLOCK IN	Connect to the output of a clock source such as an MS-101. Proper clock input is indicated by an illuminated CLOCK TRIG'D indicator.
DATA OUT	Terminate cable in 50Ω and connect to system under test data input.
	The DATA OUT signal will be in NRZ format. The same signal is available at the NRZ DECODED OUT connector, shifted ahead of the DATA OUT signal by N bits as set by the CODE LENGTH control. The RZ equivalent is available at the RZ DECODED OUT connector.
CLOCK OUT	Terminate cable in 50Ω and connect to system under test clock input.
MODE	FEEDBACK. Generator operation is indicated by an illuminated RUN indicator.
CODE LENGTH	As required.

The MN-1 now produces pseudorandom words of a length determined by the CODE LENGTH setting and at a rate determined by the clock signal connected to the CLOCK IN connector.

31.206 **DATA SCRAMBLING**

The MN-1 can be used as a data scrambler, which requires the following connections and control settings:

CLOCK IN	Connect to the output of a clock source such as an MS-101. Proper clock input is indicated by an illuminated CLOCK TRIG'D indicator.
DATA IN	Connect to the output of an external data generator such as another clock-source/MN-1 combination. Proper data input is indicated by an illuminated DATA TRIG'D indicator.
PHASING	Proper phasing of the clock input and data input is indicated by an illuminated PHASED indicator (paragraph 31.204).
CLOCK OUT	Terminate in 50Ω and connect to system-under-test clock input.
DATA OUT	Terminate in 50Ω and connect to system-under-test data input.
	The DATA OUT signal will be scrambled data in NRZ format. The same signal is available at the NRZ DECODED OUT connector, shifted ahead of the DATA OUT signal by N bits as set by the CODE LENGTH control.
	The RZ equivalent is available at the RZ DECODED OUT connector.
MODE	ENCODE
CODE LENGTH	As required.

The MN-1 now produces data output that is the input data multiplied by the pseudo-random word. The resulting product is a scrambled, unpredictable data pattern.

31.207 **DATA UNSCRAMBLING**

The MN-1 can be used as a data unscrambler, to recover signals scrambled by another MN-1, which requires the following connections and control settings.

CLOCK IN	Connect the clock output of the system under test (preferably). It can be connected to the clock output of the test generator (MN-1) but this may result in phasing problems because of the unequal delays. Proper clock input is indicated by an illuminated CLOCK TRIG'D indicator.
DATA IN	Connect to the data output of the system under test. Proper data input is indicated by an illuminated DATA TRIG'D indicator.
PHASING	Proper phasing of the clock input and data is indicated by an illuminated PHASED LED (paragraph 31.204).
Mode	DECODE
CODE LENGTH	Same as the MN-1 used to scramble the data.
DECODED OUT	The unscrambled data is available at both the NRZ and RZ DECODED OUT connectors and can be monitored on an oscilloscope or used by other external equipment as required.

The MN-1 now produces data output that is the input data pattern divided by the pseudorandom word. The resulting quotient is the original data pattern.

31.208 **ERROR DETECTION**

The MN-1 can be used as a bit error detector, which requires the following connections and control settings:

CLOCK IN	Connect to the clock output of the system under test (preferably). It can be connected to the clock output of the test generator (MN-1) but this may result in phasing problems because of the unequal delays. Proper clock input is indicated by an illuminated CLOCK TRIG'D indicator.
DATA IN	Connect to the data output of the system under test. Proper data input is indicated by an illuminated DATA TRIG'D indicator.
PHASING	Proper phasing of the clock input and data input is indicated by an illuminated PHASED indicator. (paragraph 31.204).
RZ DECODED OUT	Connect to external counter capable of counting pulses 5ns wide. A pulse will be generated at the RZ DECODED OUT connector for each error detected. The signal at the NRZ DECODED OUT connector will be high whenever an error bit is detected, for the entire data bit period. The signal at the DATA OUT connector will be the proper pseudorandom sequence.
CODE LENGTH	Same as input data word length, N.
MODE	DECODE for N consecutive error-free bits then to FEEDBACK. The internal shift register is synchronized to the incoming data pattern after N consecutive error-free bits in the DECODE Mode. Switching to FEEDBACK then locks the internal shift register to the proper pseudorandom sequence.

The MN-1 now compares the input data to the internally generated sequence on a bit-by-bit basis and produces an output at the RZ DECODED OUT connector whenever an error is detected.

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31.301 BASIC PRINCIPLES

Shift Register

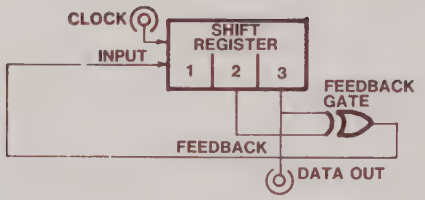
A shift register is a series of cascaded flip-flop stages. Upon application of a clock pulse, an input value is accepted into the first stage. With each succeeding clock pulse, the input value is shifted to the next stage. With no new input value, the clock pulses will eventually clear the register.

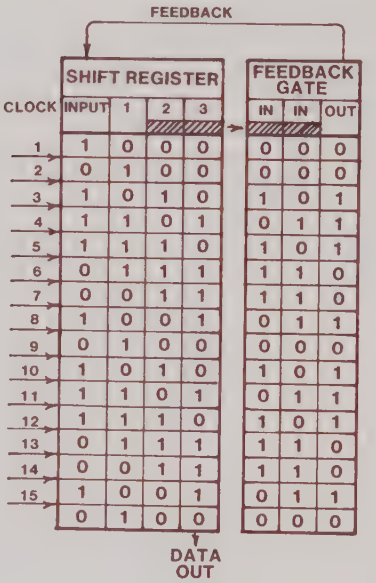
	SHIFT REGISTER			
CLOCK	INPUT	1	2	3
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	0	0	1	0
5	0	0	0	1
	0	0	0	0

Generation

In a pseudorandom generator, a feedback path containing a modulo-2 adder (two-input exclusive-or feedback gate) is added to the shift register. The inputs to the gate are taken from two stages of the shift register, and the output is fed back to the input of the register.

The resultant data out is a binary sequence of 0s and 1s that fullfills the conditions of randomness, yet is a repeating pattern. The number of bits in the pattern (sequence length) is determined by the number of stages in the shift register and the feedback taps used. The maximum sequence length is 2^n-1, where n is the number of stages and the -1 is due to the exclusion of the all -0s state of the shift register (an all -0s condition would feedback a 0 and result in a useless, continuing sequence of all 0s).





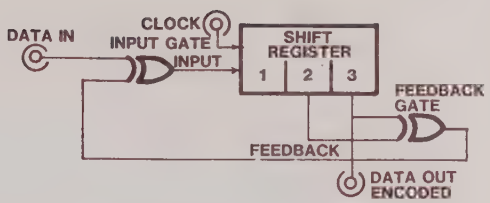
A reversed bit pattern can be obtained by altering the feedback taps.

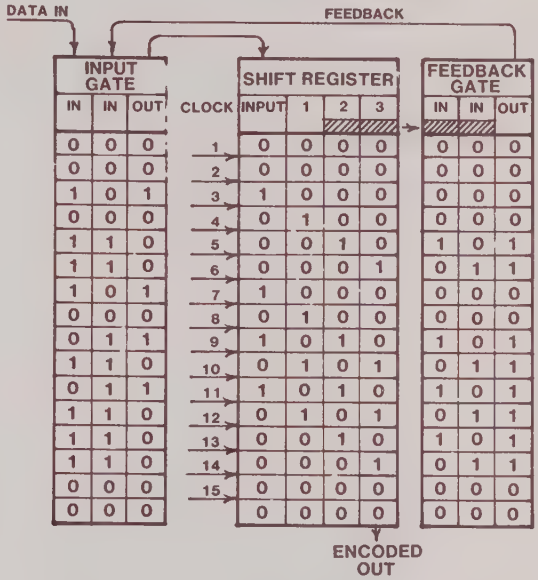
STAGES	FORWARD TAPS	REVERSE TAPS	SEQUENCE LENGTH (BITS)
3	2,3	1,3	7
4	3,4	1,4	15
5	3,5	2,5	31
6	5,6	1,6	63
7	6,7	1,7	127
8	1,6,7,8	1,2,7,8	255
9	5,9	4,9	511
10	7,10	3,10	1,023
11	9,11	2,11	2,047
12	2,10,11,12	1,2,10,12	4,095
13	1,11,12,13	1,2,12,13	8,191
14	2,12,13,14	1,2,12,14	16,383
15	14,15	1,15	32,767
16	11,13,14,16	2,3,5,16	65,535

STAGES	FORWARD TAPS	REVERSE TAPS	SEQUENCE LENGTH (BITS)
17	14,17	13,17	131,071
18	11,18	7,18	262,143
19	14,17,18,19	1,2,5,19	524,287
20	17,20	3,20	1,048,575
21	19,21	2,21	2,097,151
22	21,22	1,22	4,194,303
23	18,23	5,23	8,388,607
25	22,25	3,25	33,554,431
28	25,28	3,28	268,435,455
29	27,29	2,29	536,870,911
31	28,31	3,31	2,147,483,647
33	20,33	13,33	8,589,934,591
35	33,35	2,35	34,359,738,367
36	25,36	11,36	68,719,476,735

Encoding

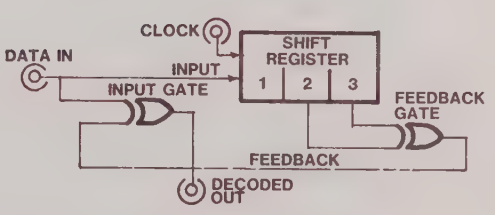
When encoding, an external data signal is applied to the input exclusive-or gate. The second input to this gate is the feed-back signal. The output of the gate is applied to the shift register and the data output from the register is the encoded signal, which is now the product of the external data signal and pseudorandom word - a scrambled, unpredictable data pattern.

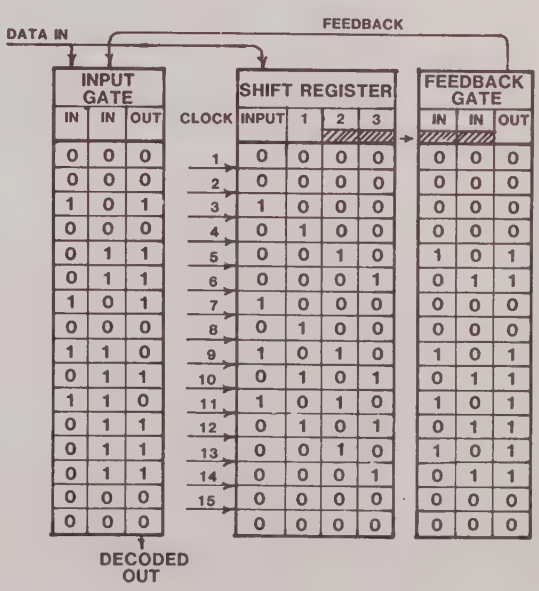




Decoding

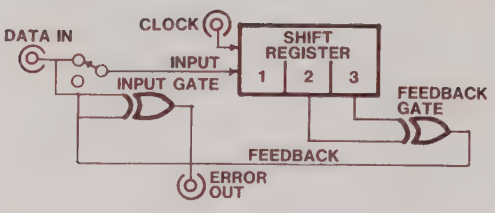
When decoding, the encoded data is applied to the input of the shift register and one input of the input gate. The inputs to the feedback gate are set so that they are from the same taps of the shift register as those used to encode the data. The feedback signal is the second input to the input gate and the output from the gate is the decoded output. Note in the example that the decoded out is the same as the data in for encoding.

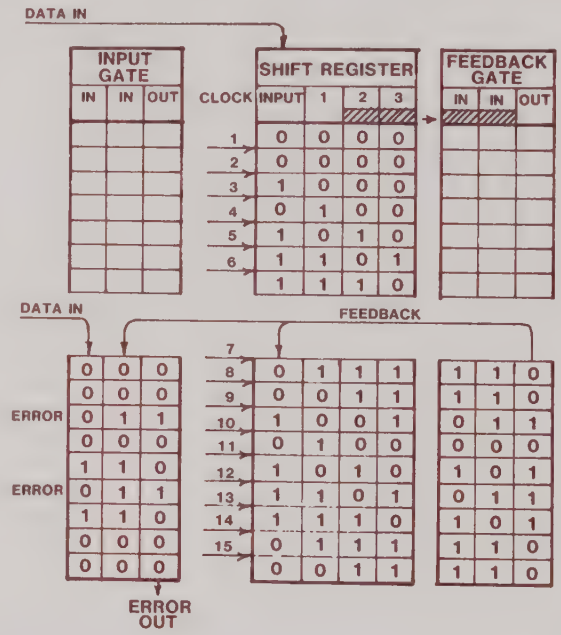




Error Detection

For error detection, the input to the shift register first comes directly from the data in (switch position 1). The inputs to the feedback gate are set so that they are from the same taps of the shift register as those used by the data in. After N consecutive error-free bits (in this example, 3) have been applied to the shift register. The register is synchronized to the data in stream.





For error detection, the input to the shift register first comes directly from the data in (switch position 1). The inputs to the feedback gate are set so that they are from the same taps of the shift register as those used by the data in. After N consecutive error-free bits (in this example, 3) have been applied to the shift register. The register is synchronized to the data in stream.

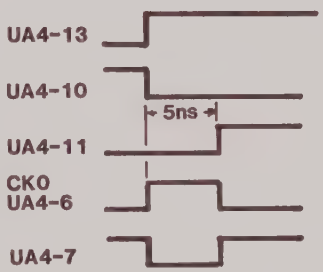
After the shift register is synchronized, its input is switched to the output of the feedback gate. The data in is applied as one input to the input gate and the feedback signal is applied as the other. The output of the input gate will be active whenever an error is detected in the data in stream.

31.302 **CLOCK**

Diagram 31A51

Clock-Input The external clock signal is applied to J504 on the front panel and through J101 to the input of differential amplifier Q101-Q102 which buffers it and converts it to an ECL level referenced to -2V.

Clock Shaper The clock output from Q102c feeds UA4-13. The output from UA4-14 is applied directly to one input of negative and-gate UA4-10. The output from UA4-15 is applied through a 5ns delay line to the second input of UA4 at pin 11. The resultant outputs at pins 6 and 7 are fixed clock pulse widths of 5ns, independent of the input clock frequency.



Clock Distribution The 5ns clock pulse from UA 4-7 is applied to a set of five inverters that provide positive buffered clock outputs CK1 thru CK9 to the other circuits.

One signal, CKO from UA4-6 is used directly from the shaper.

Clock Status The positive clock pulse CKO drives a toggle-configured flip-flop UA1 whose output at pin 15 is capacitively coupled to Q103b. Q103 thus responds only to transitions. The output of Q103 drives the CLOCK TRIG'D front-panel LED. With the proper clock signal applied and at the usual operating frequencies the LED appears lit continuously.

Diagrams 31A52 and 31A53

CLOCK OUT Amplifier Another clock signal, from UA3-12, is applied via J103 to the clock amplifier on the 31A52 Output Amplifiers board and thence to J503, the CLOCK OUT connector on the front-panel.

31.303 **DATA**

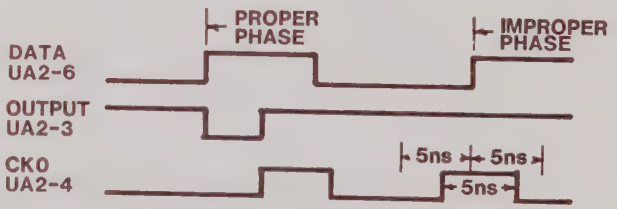
Diagram 31A51

Data Input The external input signal is applied to J505 on the front panel and through J102 to the input of differential amplifier Q104-Q105 which buffers it and converts it to an ECL level referenced to -2V.

Data Latch The buffered data from UB4-7 is applied to the D input of the data latch UB3 at pin 7 and clocked in by CK1. The output of the data latch at UB3 pins 2 and 3 is applied to the input gate and/or first stage of the shift register depending on the setting of the Mode switch S501.

Data Status The buffered data from UB4-6 drives a toggle-configured flip-flop UA1 whose output at pin 2 is capacitively coupled to Q108b. Q108 thus responds only to transitions. The output of Q108 drives the DATA TRIG'D front-panel LED. With the proper data signal applied and at the usual operating frequencies the LED appears lit continuously.

Phase Status The buffered data from UB4-6 clocks D flip-flop UA2, at pin 6, whose D input is always hi via D11 to ground.

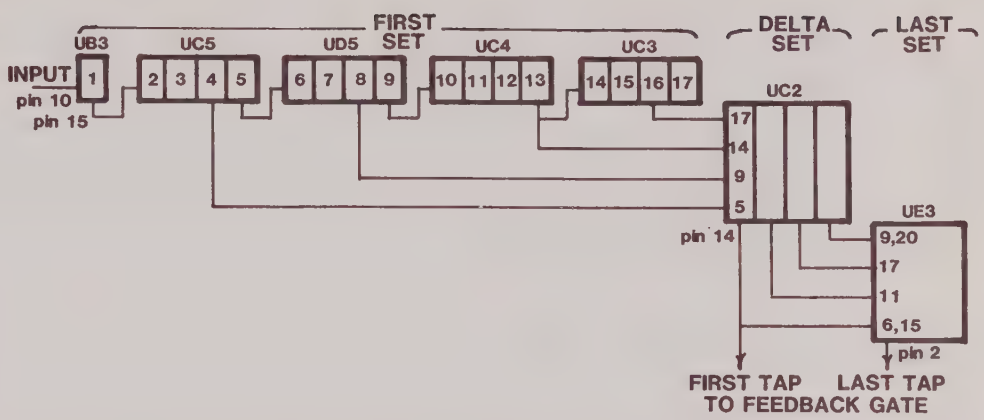


When the data is properly phased with respect to the clock CKO at the reset input at pin 4, the data at the clock input sets the output of UA2 at pin 3 lo and CKO resets it hi. The positive transitions drive a toggle-configured flip-flop whose output at pin 15 is capacitively coupled to Q106b. Q106b thus responds only to transitions. The output of Q106 drives the PHASED front-panel LED. With proper phasing between the clock input and data input and at the usual operating frequencies the LED appears lit continuously.

When the data is improperly phased with respect to the clock CKO at the reset input at pin 4 (within 5ns of the positive transition of the clock), the output of UA2 at pin 3 is held hi and not allowed to respond to the data at pin 6. Thus UA2-15 remains a dc level, no transitions reach Q106, and the PHASED LED remains extinguished.

31.304 **SHIFT REGISTER**

Diagram 31A51



In order to eliminate phasing problems caused by device propogation delays, the shift register is reconfigured slightly to include a delta set and a last set.

First Set — The first-set is a normal series of cascaded flip-flops.

RUN Status — The Q^1 output from the first stage at UB3-14 is applied through UB4 whose output at pin 14 is capacitively coupled to Q107b. Q107 thus responds only to transitions. The output of Q107 drives the RUN front-panel LED. When the shift register is running at the usual operating frequencies the LED appears lit continuously.

Delta Set — The delta set is simply another set of cascaded flip-flops that adds from 1 to 4 stages to the register. The first tap from the register to the feedback gate is always connected to the first stage of the delta set.

Last Set — The last set is a single flip-flop that adds 1 stage to the register. The last tap from the register to the feedback is always connected to the output of the last set.

Operation

Code	NORMAL		MN-1	
Length	First Tap	Last Tap	Delta Set	Last Set
6	5	6	4	1
9	5	9	4	4
11	9	11	8	2
15	14	15	13	1
17	14	17	13	3
20	17	20	16	4

In operation, for example, taps at 9 and 11 in a normal register are achieved in this unit by connecting stage 8 of the first set to the delta set input (8+1=9) and connecting the 2nd stage of the delta set to the last set (8+2+1=11).

CODE LENGTH

Inputs to the delta set are controlled by five gates, UE4 (output pins 2, 15, and 14), UE2 (output pin 3), and UD3 (output pin 14).

Inputs to the last set are controlled by four gates, UD2 (output pins 2, 14, 15, and 3).

These gates, in turn, are selected by the CODE LENGTH switch S503 via a diode matrix D107 thru D126.

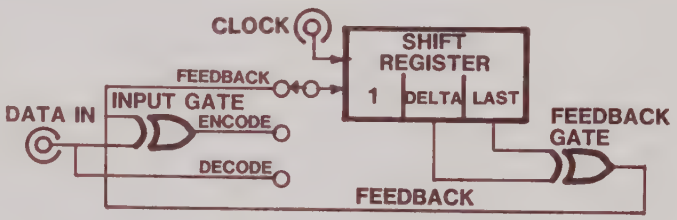
DATA OUT Amplifier

In addition to a connection to the feedback gate, one output from the last set at UE3-3 is applied via UE2-11 to the data amplifier on the 31A52 Output Amplifiers board and thence to J506, the DATA OUT connector on the front panel.

31.305 **FEEDBACK AND INPUT GATES**

Diagram 31A51

The feedback gate consists of two exclusive-or gates (UD1 with outputs at pins 14 and 15). One output is the first tap of the shift register from the delta set UC2-14. The second input is the last tap of the shift register from the last set UE3 pins 2 and 3.



FEEDBACK Mode

In the FEEDBACK mode, the output of the feedback gate is connected to the first stage of the shift register via gate UB2 (output pin 2). UB2 is enabled by the hi level from UE1-3 as set by the FEEDBACK position of the MODE switch S502 via UB1-7.

ENCODE Mode

In the ENCODE mode, the output of the feedback gate is connected to the input gate UC1-13. The second input at UC1-12 is from the data latch UB3-2. The input gate is enabled by the third input UC1-11 via UB1-2 and the ENCODE position of the MODE switch S502. The output of UC1 at pin 14 is applied to the first stage register at UB3-10.

DECODE Mode

In the DECODE mode, the output of the feedback gate is connected to the input gate UC1-4. The second input at UC1-6 is from the data latch UB3-3. The input gate is enabled by the third input UC1-5 via UB1-2 and the DECODE position of the MODE switch S502. The output of UC1 at pin 3 is applied to the first stage of the shift register at UB3-10.

Diagrams 31A51 and 31A52

RZ-NRZ Amplifier

The output of the feedback gate is also connected to a second input gate UD1-3. The second input at UD1-5 is from the data latch UB3-2. The output of the second input gate at UD1-2 is fed to flip-flop UE1 at pin 10. The outputs of UE1 at pins 14 and 15 are applied to the RZ and NRZ amplifiers on the 31A42 Output Amplifiers board and thence to J502 and J501, the RZ and NRZ DECODED OUT connectors on the front panel.

31.306 **RESTART**

Diagram 31A51

Zero Detection — Because an all-0s state of the shift register would result in a useless, continuing sequence of all 0s, the output of each state in the shift register is connected to the input of a gate to detect an all-0s condition (UB4-13; UE5-13,-11,-10,-9; UE5-5,-6,-7; UD4-12, UD4-10,-9,-11, UD4-4,-5, UD3-9,-10,-11). The outputs of these gates are applied to UF3 whose output at pin 14 is hi whenever all shift register stages are zero.

Restart — This hi-level is applied through gate UB4, appears at the output pin 2, and sets the first stage of the shift register to 1.

TEST — This same gate also accepts a hi-level from the TEST pushbutton when it is depressed and sets the first stage to 1. As long as the TEST pushbutton is held depressed, each clock pulse will set each stage of the shift register to 1 until all stages are set to 1.

Sync Detection — The 0s information from all stages except the first is applied to UF3 at pins 4 and 6. The third input to UF3 at pin 7 is the 1-state of the first stage of the shift register. When the first stage is 1 and all other stages are 0, UE3 produces a pulse at pin 15.

Diagram 31A52

Sync Out — The output from UE3-15 is applied to the sync amplifier on the 31A52 Output Amplifier board and thence to J507, the SYNC OUT connector on the front panel.

31.307 **REGULATOR**

Diagram 31A22

Unregulated + and -17V from the mainframe power supply is applied to P603 pins 4 and 16 and 6 and 18 respectively. Regulators VR601 and VR602 connected to these pins provide regulated +5V and -5.2V for the circuits in the module. Q601 provides additional current capacity for the -5.2V supply.

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31.401 ROUTINE SERVICE

None required.

31.402 REPAIR RETURNS

To return a unit for repair:

1. Call the Customer Service Dept., (617)256-9013, for a Repair Authorization Number. This will reduce administrative delays and ensure prompt return of your unit.
2. Complete and attach the Repair Tag, in the rear of the manual, to your unit for positive identification.
3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb) and shock absorbing material such as bubblewrap to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.
4. Send to: Tau-Tron
   27 Industrial Ave.
   Chelmsford, MA 01824
   Attn: Customer Service

31.403 TEST PROCEDURE

Equipment

The specifications given are those necessary to perform the tests and are not necessarily those of the suggested equipment.

a.	Mainframe	Tau-Tron Modular Instrument (TMI) MF-2, MF-3, or MF-5 Mainframe.
b.	Oscillator	1kHz to 75MHz, 2V p-to-p output. Tau-Tron MS-101.
c.	Autotransformer	Capable of varying input ac line ±10%, 300W, with output ac voltmeter. Variac W5MT3VM (115V line) or Variac M5HMT with separate ac voltmeter (230V line).
d.	Voltmeter	4.2 to 5.3V dc, 5000Ω/V. Triplett 630.
e.	Oscilloscope	1.8ns risetime, 25mV to 2V/div sensitivity, dual trace. Tektronix 475.
f.	50Ω terminations	Two; 50Ω terminations with BNC connectors. Kings 1340-1.

Procedure

1. Initial setup

Turn off the mainframe, remove all modules, and connect the mainframe to a variable ac line.

Insert the MN-1 into the second position from the left in the mainframe.

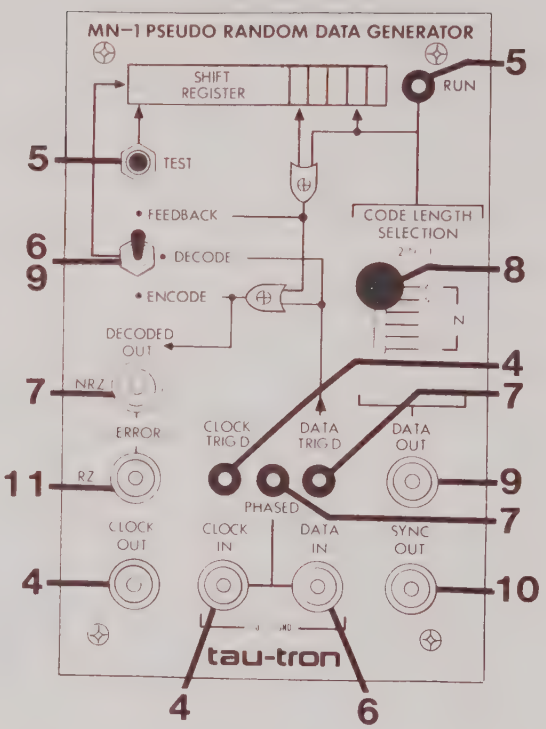
2. +5V supply

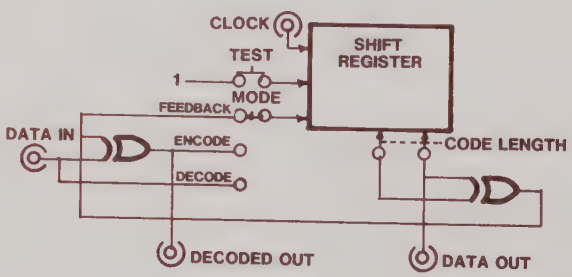
Connect a dc voltmeter and an oscilloscope to the +5V bus.

Set the ac line for the nominal supply voltage (100, 115, 125, 200, 230, or 250V) and turn on the mainframe power. The +5V supply must be +4.9 to +5.1V and ripple must be 50mV p-to-p max, 120Hz.

Reduce the line voltage to the low end (90,105,115,180,210, or 230V). The +5V supply must remain within 0.1V of +5V and ripple must remain at or below 50mV p-to-p.

Increase the line voltage to the high end (110,125,135,220,250,or 270V). The +5V supply must remain within 0.1V of +5V and ripple must remain at or below 50mV p-to-p.





3. -5.2V supply

Change the dc voltmeter and oscilloscope to the -5.2V bus.

Set the ac line for the nominal line voltage. The -5.2V supply must be -5.1 to -5.3V and ripple must be 50mV p-to-p max, 120Hz.

Reduce the line voltage to the low end. The -5.2V supply must remain within 0.1V of -5.2V and ripple must remain at or below 50mV p-to-p.

Increase the line voltage to the high end. The -5.2V supply must remain within 0.1V of -5.2V and ripple must remain at or below 50mV p-to-p.

Disconnect the voltmeter and oscilloscope from the output of the -5.2V regulator and return the line voltage to its nominal value.

4. CLOCK OUT, CLOCK TRIG'D

Mode	DECODE
CODE LENGTH...	6
CLOCK IN	Connect to output of clock source set to 1kHz
CLOCK OUT.....	Connect to input of oscilloscope, terminated in 50Ω.

CLOCK TRIG'D indicator must light when input clock signal is connected.

Vary input clock frequency from 1kHz to 75 MHz. CLOCK OUT amplitude must be 1.7 to 2.3V p-to-p and duration must be 5ns min.

5. TEST, RUN, shift operation

DATA OUT.....	Connect to second input of oscilloscope, terminated in 50Ω .
Mode.....	Leave at DECODE
CODE LENGTH...	Leave at 6
CLOCK IN.....	Leave at output of clock source.
CLOCK OUT.....	Leave at input of oscilloscope.

Push and release TEST button. RUN indicator must light momentarily when TEST button is released.

Push and hold TEST button, DATA OUT must be all 1's (high level). Release TEST button. DATA OUT must be all 0's (low level). Repeat for all settings of CODE LENGTH from 6 to 20.

Disconnect DATA OUT oscilloscope and set CODE LENGTH to 6.

6. DECODE, DATA IN, feedback gate

DATA OUT.....	Connect to DATA IN
NRZ OUT.....	Connect to second input of oscilloscope, terminated in 50 Ω.
CODE LENGTH...	6
Mode.....	Leave at DECODE
CLOCK IN.....	Leave at output of clock source
CLOCK OUT.....	Leave at input of oscilloscope

Push and hold TEST button NRZ OUT must be all 1's (high level). Release TEST button. NRZ OUT must remain all 1's (high level).

Disconnect DATA OUT from DATA IN. NRZ OUT must be all 0's (low level).

7. NRZ OUT, PHASED, DATA TRIG'D

DATA OUT.....	Disconnected
NRZ OUT.....	Leave at second input of oscilloscope.
CODE LENGTH...	Leave at 6
Mode.....	Leave at DECODE
CLOCK IN.....	Leave at output of clock source
CLOCK OUT.....	Leave at input of oscilloscope

Leave DATA OUT disconnected momentarily to clear shift register of any 1's. Turn off CLOCK IN (if clock source is an MS-101 without crystals, clock can be turned off by setting VCO-CRYSTAL control to CRYSTAL. Otherwise turn off clock by disconnecting CLOCK IN from clock source).

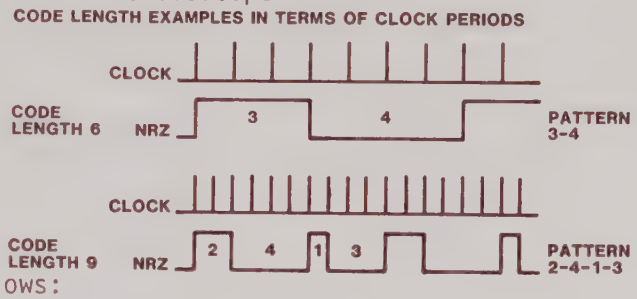
Reconnect DATA OUT to DATA IN. Push and release TEST button to set first stage to 1. Turn on (or reconnect) CLOCK IN to activate shift register (circulating 1). PHASED, DATA TRIG'D, and RUN indicators must light.

Vary the input clock frequency from 1kHz to 75mHz. The NRZ OUT amplitude must be 1.7 to 2.3V p-to-p.

8. CODE LENGTH

DATA OUT..... As required for circulating 1's.
CLOCK IN..... As required for circulating 1's.
NRZ OUT..... Leave at second input of oscilloscope
CODE LENGTH... Leave at 6
Mode..... Leave at DECODE
CLOCK OUT..... Leave at input of oscilloscope

Again obtain a circulating 1's pattern by momentarily disconnecting DATA OUT from DATA IN, turning off CLOCK IN, reconnecting DATA IN, pushing TEST button, and turning on CLOCK IN.



The patterns must be as follows:

CODE LENGTH	PATTERN	NOTE
6	3-4	Each time the CODE LENGTH is changed the circulating 1's pattern must be restarted. Increase input clock frequency as required for flicker-free display.
9	2-4-1-3	
11	2-8-1-1	
15	3-13	
17	2-13-1-2	
20	2-16-1-2	

9. FEEDBACK, DATA OUT, ENCODE

NRZ OUT..... Disconnect
DATA OUT..... Connect to second input of oscilloscope terminated in 50Ω
CLOCK IN..... Connect to output of clock source
Mode..... FEEDBACK
CODE LENGTH... 6
CLOCK OUT..... Leave at input of oscilloscope

Vary the input clock frequency from 1kHz to 75 MHz. The DATA OUT amplitude must be 1.7 to 2.3V p-to-p and the pattern must not vary with the frequency.

Change Mode to ENCODE. The DATA OUT signal must be the same pattern as in the FEEDBACK mode.

10. SYNC OUT

DATA OUT..... Disconnect
SYNC OUT..... Connect to second input of oscilloscope terminated in 50Ω
Mode..... FEEDBACK
CODE LENGTH... 6
CLOCK IN..... Leave at output of clock source
CLOCK OUT..... Leave at input of oscilloscope

Vary the input clock frequency from 1kHz to 75MHz. The SYNC OUT amplitude must be 1.7 to 2.3V p-to-p and the duration must be equal to the CLOCK OUT period.

11. RZ OUT

SYNC OUT.....	Disconnect
RZ OUT.....	Connect to second input of oscilloscope, terminated in 50Ω
Mode	Leave at FEEDBACK
CODE LENGTH...	Leave at 6
CLOCK IN.....	Leave at output of clock source
CLOCK OUT.....	Leave at input of oscilloscope

Vary the input clock frequency from 1kHz to 75MHz. The RZ OUT amplitude must be 1.7 to 2.3V p-to-p, the duration must be 5ns min, and the pattern must not vary with frequency.

31.500 **CONTENTS**

31.501 Replaceable Parts.....page 31-501

31.501 **REPLACEABLE PARTS**

Reference designations include unit and assembly prefixes.

Ref Des	Description	Tau-Tron No.
31A11	**FRAME**	
31A11	Rails, four rails total, supplied in sets of two each (top and bottom), per set.....	9705-4018B
31A11	Shield, formed aluminum..... Secured to rails by four 5-40 X 25in Phillips-head machine screws	9705-3395
31A11 P101	Plug for data in.....	9301-0058
31A11 P102	Plug for clocking.....	9301-0058
31A11 P103	Plug for buffered clock.....	9301-0058
31A11 P104	Plug for front-panel signals, 16-pin.....	9300-0050
31A11 P201	Plug for buffered clocks.....	9301-0058
31A11 P605	Jack to front-panel, 16-pin.....	9300-0050
31A11 XA51	Connector, 22-pin, edge.....	9300-0012
31A11 XA52	Connector, 22-pin, edge.....	9300-0012
31A21	**REAR PANEL**	
31A21	Panel only, drilled, without components..... Secured to rails by four 5-40 X 3/8 in Phillips-head machine screws	9705-3531C
31A22	**REGULATOR**	
31A22 C601	Capacitor, 20% 200V, 1μF ceramic.....	1014-4610
31A22 C602	Capacitor, 20% 200V, 1μF ceramic.....	1014-4610
31A22 C603	Capacitor, 20% 35V, 1μF ceramic.....	1024-5110
31A22 C604	Capacitor, 20% 35V, 4.7μF tantalum.....	1024-5147
31A22 C605	Capacitor, 20% 35V, 1μF tantalum.....	1024-5110
31A22 C606	Capacitor, 20% 35V, 10μF electrolytic.....	1024-5210
31A22 D601	Diode.....	1024-A15A
31A22 P603	Plug, 24-pin male, chassis mounted.....	9300-0103
31A22 Q601	Transistor.....	3180-5301

Ref Des	Description	Tau-Tron No.
31A22 R601	Resistor, 100Ω ±5% 1/4W composition.....	0022-3100
31A22 R602	Resistor, 3Ω ±5% 1/4W composition.....	0022-1300
31A22 R603	Resistor, 300Ω ±5% 1/4W composition.....	0022-3300
31A22 R604	Resistor, 12Ω ±5% 1/4W composition.....	0022-2120
31A22 TB601	Terminal board, 4 terminal.....	9110-0100
31A22 VR601	Voltage regulator, LM340K-05,+5V..... Uses Keystone 4606 TO-3 mounting socket Thermalloy 4726A TO-3 annodized aluminum heat sink Two Motorola B515475002 nylon bushings Secured with two 6-32X1/2in. slotted hex-head self-tapping screws	4200-340K5
31A22 VR602	Voltage regulator, LM320K-5.0,-5.2V..... Uses Keystone 4606 TO-3 mounting socket Thermalloy 4726A TO-3 annodized aluminum heat sink Two Motorola B515475002 nylon bushings Secured with two 6-32 X 1/2in. slotted hex-head self-tapping screws	4200-320K5
31A31	**FRONT PANEL**	
31A31	Panel only, drilled, painted, silk-screened, without components..... Secured to rails by four 5.40 X 3/8 in. Phillips-head machine screws	9705-3060
31A31 DS501	CLOCK TRIG'D light-emitting diode.....	2274-5053
31A31 DS502	PHASED light-emitting diode.....	2274-5053
31A31 DS503	DATA TRIG'D light-emitting diode.....	2274-5053
31A31 DS504	RUN light-emitting diode.....	2274-5053
31A31 J501	NRZ (ERROR) connector, BNC female.....	9301-0001
31A31 J502	RZ (ERROR) connector, BNC female.....	9301-0001
31A31 J503	CLOCK OUT connector, BNC female.....	9301-0001
31A31 J504	CLOCK IN connector, BNC female.....	9301-0001
31A31 J505	DATA IN connector, BNC female.....	9301-0001
31A31 J506	DATA OUT connector, BNC female.....	9301-0001
31A31 J507	SYNC OUT connector, BNC female.....	9301-0001
31A31 S501	TEST switch, 1p2t momentary pushbutton.....	9203-0000
31A31 S502	MODE switch, 3p3t toggle.....	9200-0009
31A31 S503	CODE LENGTH switch, 1p6t slide; ..... Uses knob Alco KSS-3B.....	9201-0001 9800-KSSS3B

Ref Des	Description	Tau-Tron No.
31A51	**PR GENERATOR**	
31A51 C101	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A51 C102	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A51 C103	Capacitor, 20% 6V, 47 μF miniature tantalum	1064-0847
31A51 C104	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A51 C105	Capacitor, 20% 6V, 47μF miniature tantalum	1064-0847
31A51 C106	Capacitor, 20% 6V, 47μF miniature tantalum	1064-0847
31A51 C107	Capacitor, 20% 6V, 47μF miniature tantalum	1064-0847
31A51 C108 thru 31A51 C120	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A51 C121	Capacitor, 20% 10V, 33μF miniature tantalum	1064-1233
31A51 C122	Capacitor, 20% 10V, 33μF miniature tantalum	1064-1233
31A51 C123	Capacitor, 20% 10V, 33μF miniature tantalum	1064-1233
31A51 C501 thru 31A51 C553	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A51 D101 thru 31A51 D126	Diode	2112-4148
31A51 DL1	Delay line, 40 in. 5ns	
31A51 DL2	Delay line, 30 in. 3.75ns	
31A51 J101	Connector for data in	9301-0060
31A51 J102	Connector for clock in	9301-0060
31A51 J103	Connector for buffered clock	9301-0060
31A51 J605	Connector to front-panel, 16-pin	9300-0030
31A51 Q101 thru 31A51 Q108	Transistor	3224-5771
31A51 R101	Resistor, 51Ω ±5% 1/8W composition	0012-2510
31A51 R102	Resistor, 100Ω ±5% 1/8W composition	0012-3100
31A51 R103	Resistor, 130Ω ±5% 1/8W composition	0012-3130
31A51 R104	Resistor, 100Ω ±5% 1/8W composition	0012-3100
31A51 R105	Resistor, 390Ω ±5% 1/8W composition	0012-3390
31A51 R106	Resistor, 100Ω ±5% 1/8W composition	0012-3100
31A51 R107	Resistor, 390Ω ±5% 1/8W composition	0012-3390
31A51 R108	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
31A51 R109	Resistor, 7.5Ω ±5% 1/8W composition	0012-4750
31A51 R110	Resistor, 20Ω ± 5% 1/8W composition	0012-2200
31A51 R111	Resistor, 51Ω±5% 1/8W composition	0012-2510
31A51 R112	Resistor, 100Ω ±5% 1/8W composition	0012-3100
31A51 R113	Resistor, 130Ω ±5% 1/8W composition	0012-3130
31A51 R114	Resistor, 100Ω ±5% 1/8W composition	0012-3100
31A51 R115	Resistor, 390Ω ±5% 1/8W composition	0012-3390

Ref Des	Description	Tau-Tron No.
31A51 R116	Resistor, 100Ω ±5% 1/8W composition.....	0012-3100
31A51 R117	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
31A51 R118	Resistor, 7.5Ω ±5% 1/8W composition.....	0012-4750
31A51 R119	Resistor, 20Ω ±5% 1/8W composition.....	0012-2200
31A51 R120	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
31A51 R121	Resistor, 7.5 kΩ ±5% 1/8W composition.....	0012-4750
31A51 R122	Resistor, 20Ω ±5% 1/8W composition.....	0012-2200
31A51 R123	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
31A51 R124	Resistor, 7.5kΩ ±5% 1/8W composition.....	0012-4750
31A51 R125	Resistor, 20Ω ±5% 1/8W composition.....	0012-2200
31A51 R126	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
31A51 R127	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
31A51 R128 thru 31A51 R131	Resistor, 68Ω ±5 % 1/8W composition.....	0012-2680
31A51 R132 thru 31A51 R137	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
31A51 R138 thru 31A51 R144	Resistor, 100Ω ±5% 1/8W composition.....	0012-3100
31A51 R145	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
31A51 R146	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
31A51 R147	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
31A51 R148	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
31A51 R149	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
31A51 R150	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
31A51 R151	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
31A51 R152	Resistor, 69Ω ±5% 1/8W composition.....	0012-2680
31A51 R153	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
31A51 R154	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
31A51 R155	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
31A51 R156	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
31A51 R157	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
31A51 R158	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
31A51 R159	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
31A51 R501 thru 31A51 R580	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470

Ref Des	Description	Tau-Tron No.
31A51 UA1	Integrated circuit,	4012-10131
31A51 UA2	Integrated circuit,	4012-10131
31A51 UA3	Integrated circuit,	4012-10211
31A51 UA4	Integrated circuit,	4012-10105
31A51 UB1	Integrated circuit,	4012-10105
31A51 UB2	Integrated circuit,	4012-1662
31A51 UB3	Integrated circuit,	4012-10131
31A51 UB4	Integrated circuit,	4012-10105
31A51 UC1	Integrated circuit,	4012-1660
31A51 UC2 thru 31A51 UC5	Integrated circuit,	4012-10141
31A51 UD1	Integrated circuit,	4012-1672
31A51 UD2	Integrated circuit,	4012-10102
31A51 UD3	Integrated circuit,	4012-10105
31A51 UD4	Integrated circuit,	4012-10105
31A51 UD5	Integrated circuit,	4012-10141
31A51 UE1	Integrated circuit,	4012-10131
31A51 UE2	Integrated circuit,	4012-10101
31A51 UE3	Integrated circuit,	4012-10131
31A51 UE4	Integrated circuit,	4012-10102
31A51 UE5	Integrated circuit,	4012-10109
31A51 UF3	Integrated circuit,	4012-10109
31A51 UF4	Integrated circuit,	4012-10102
31A51 UF5	Integrated circuit,	4012-10102
31A52	**OUTPUT AMPLIFIERS**	
31A52 C201	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A52 C202	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A52 C205	Capacitor, 20% 10V, 33μF miniature tantalum	1064-1233
31A52 C206 thru 31A52 C210	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A52 C211	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A52 C212	Capacitor, 20% 10V, 33μF miniature tantalum	1064-1233
31A52 C213 thru 31A52 C216	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A52 C218	Capacitor, 20% 50V, .01μF chip bypass	1084-4710
31A52 C219	Capacitor, 20% 10V, 33 μF miniature tantalum	1C64-1233

Ref Des	Description	Tau-Tron No.
31A52 C220 thru 31A52 C223	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
31A52 C226	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
31A52 C227	Capacitor, 20% 50V, .01μF miniature tantalum.....	1084-4710
31A52 C228	Capacitor, 20% 50V, 220μF electrolytic.....	1024-1322
31A52 C229	Capacitor, 20% 10V, 220μF electrolytic.....	1024-1322
31A52 C230	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
31A52 C231	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
31A52 C234	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
31A52 C235	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
31A52 C501 thru 31A52 C504	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
31A52 J201	Connector for buffered clock; right-angle	9301-0056
31A52 Q201 thru 31A52 Q204	Transistor, ...	3302-2784
31A52 Q205	Transistor, ...	3224-5771
31A52 Q206	Transistor, ...	3224-5771
31A52 Q207 thru 31A52 Q210	Transistor, ...	3302-2784
31A52 Q211	Transistor, ...	3224-5771
31A52 Q212	Transistor, ...	3224-5771
31A52 Q213 thru 31A52 Q216	Transistor, ...	3302-2784
31A52 Q217	Transistor, ...	3224-5771
31A52 Q218	Transistor, ...	3224-5771
31A52 Q219 thru 31A52 Q222	Transistor, ...	3302-2784
31A52 Q223	Transistor, ...	3224-5771
31A52 Q224	Transistor, ...	3224-5771
31A52 Q225 thru 31A52 Q228	Transistor, ...	3302-2784
31A52 Q229	Transistor, ...	3324-5771
31A52 Q230	Transistor, ...	3224-5771

Diagrams

31.600 **CONTENTS**

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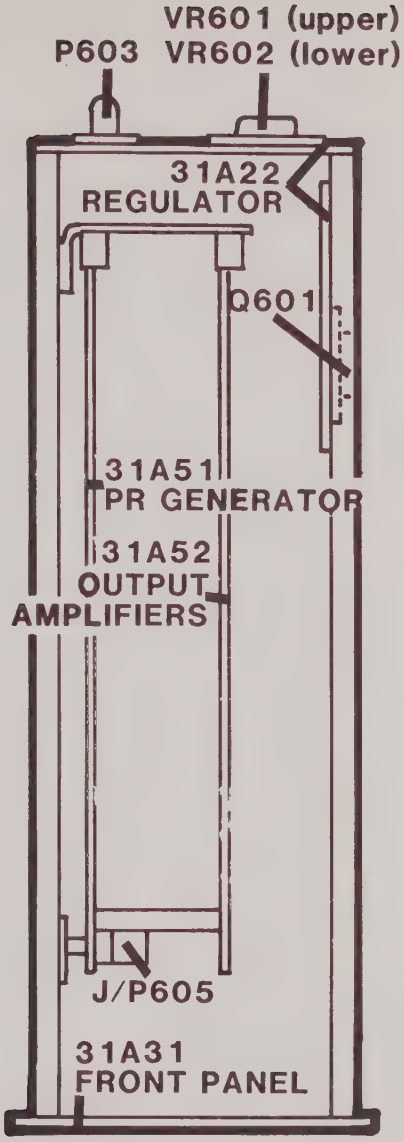
31A11 Frame..... ---
31A21 Rear Panel..... ---
31A22 Regulator..... 31-605
31A31 Front Panel..... 31-607
31A51 PR Generator..... 31-609
31A52 Output Amplifiers.. 31-613



PARTS VALUES

Unless noted otherwise:

C in μF
L in μH
R in Ω
* special, see parts list

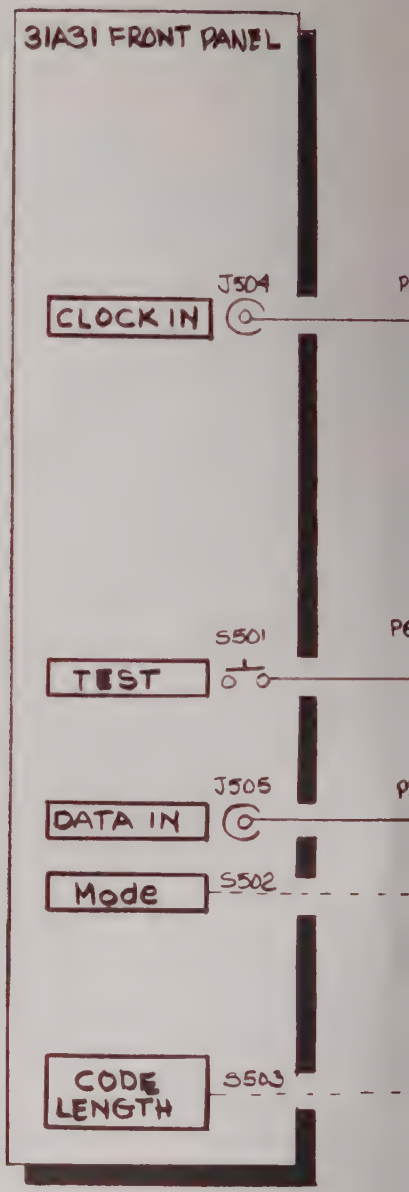
For full type numbers of ICs and transistors, see parts list

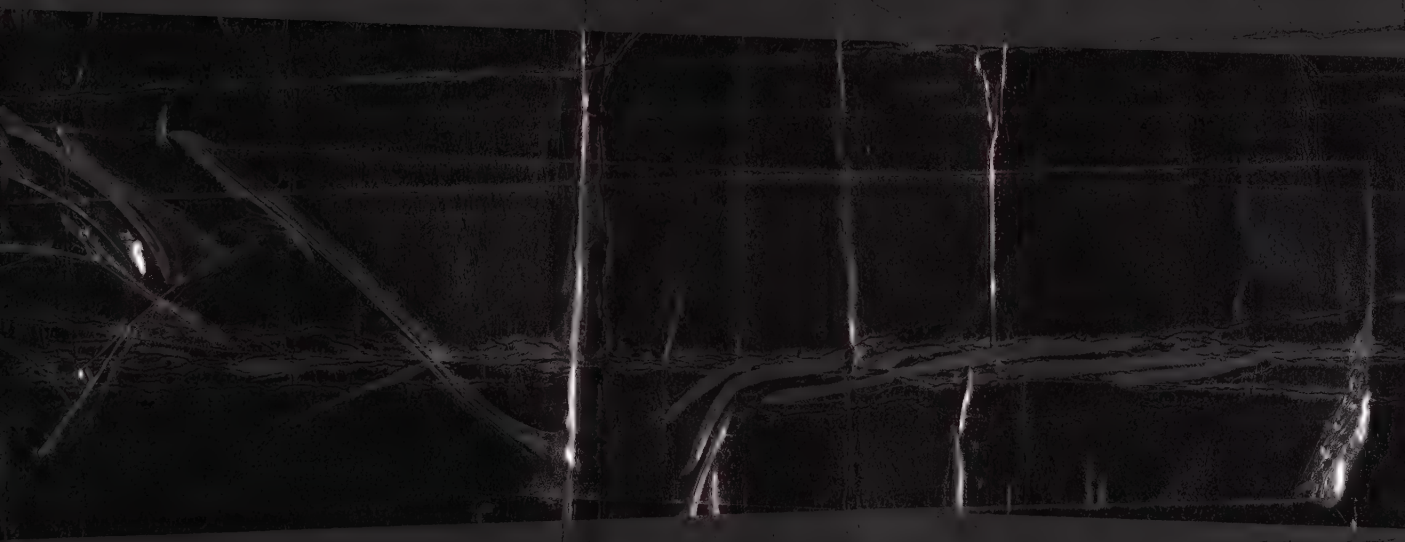
REFERENCE DESIGNATIONS

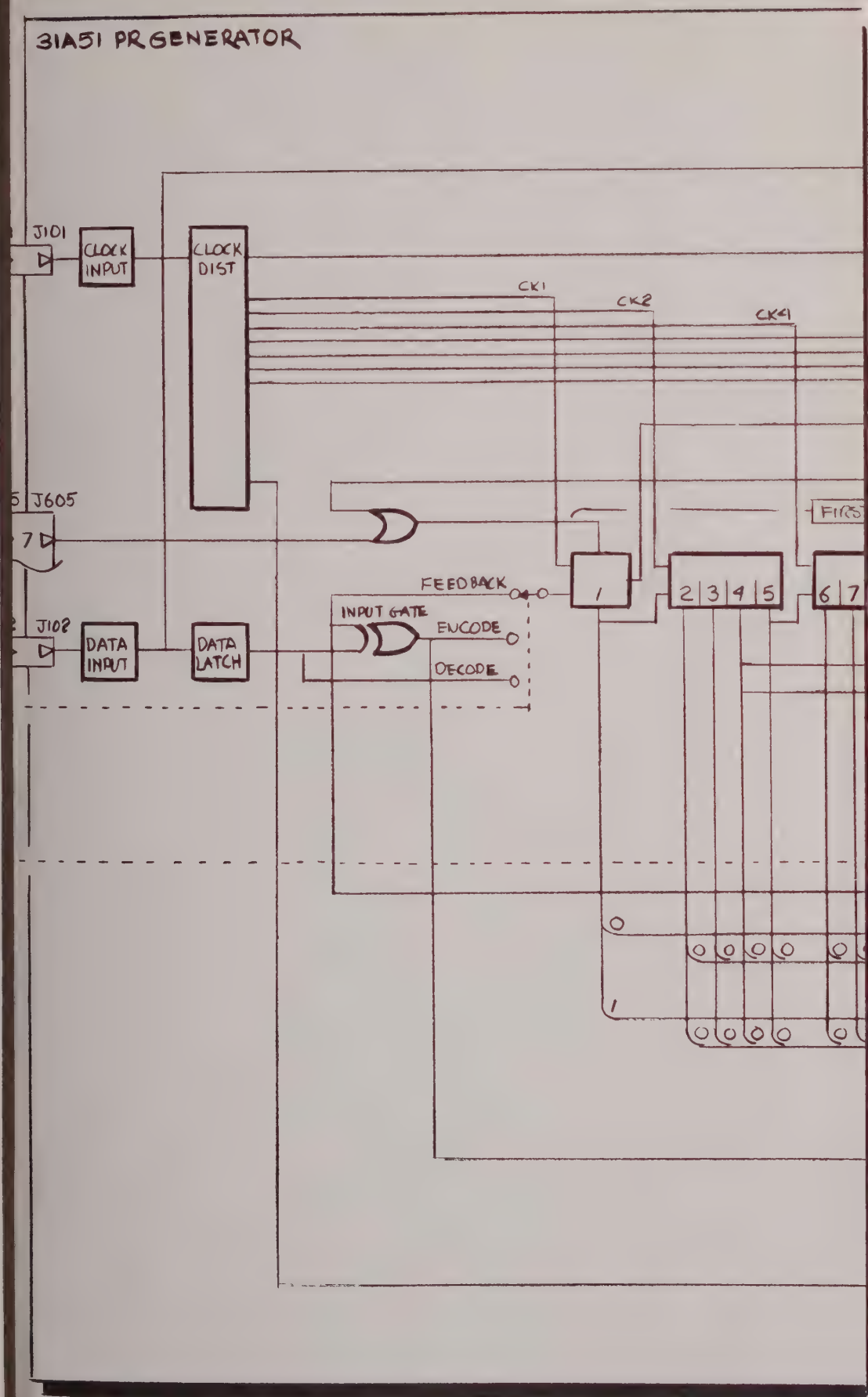
Full reference designations include assembly prefix

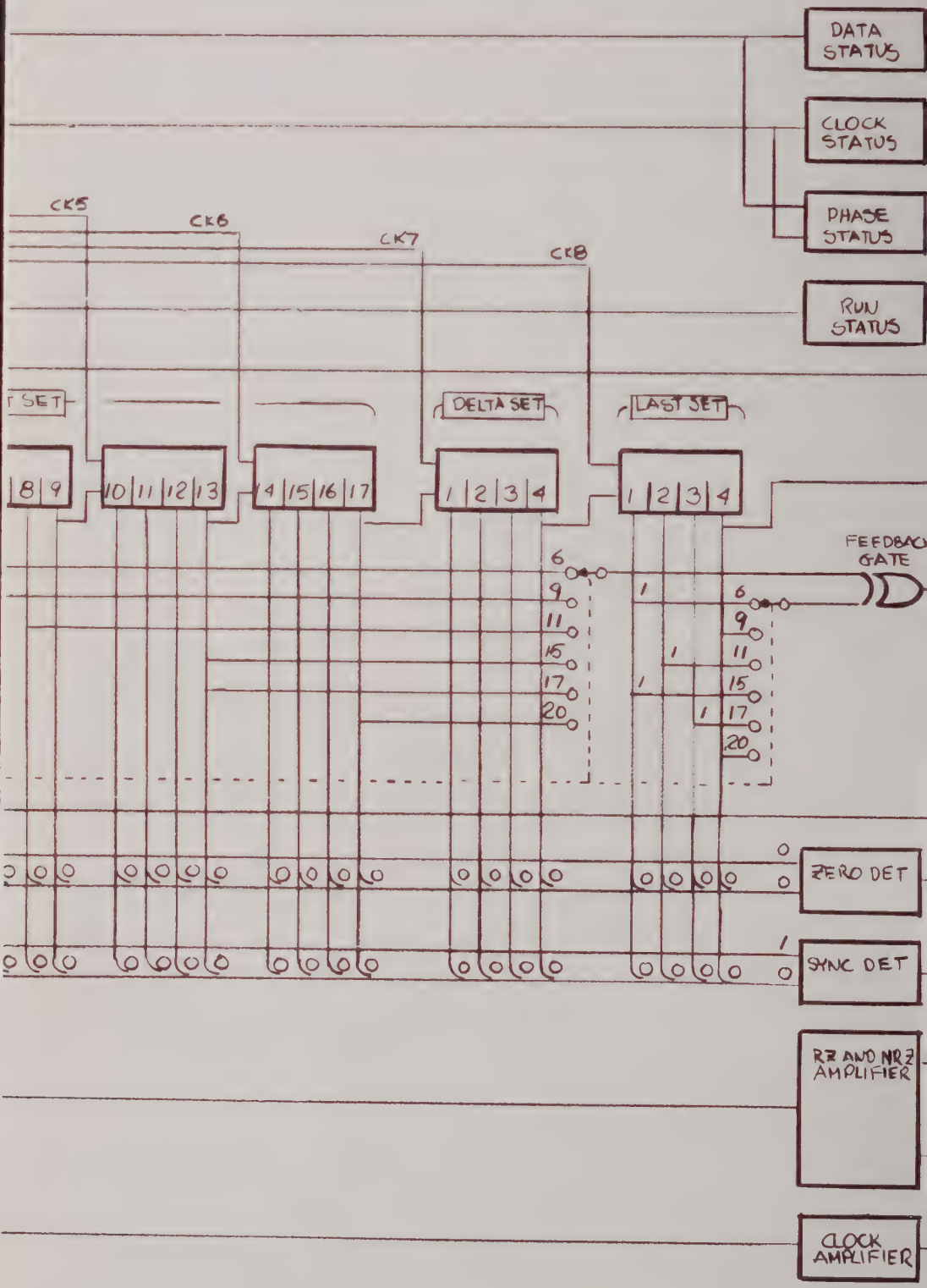
SIGNAL ORIGIN

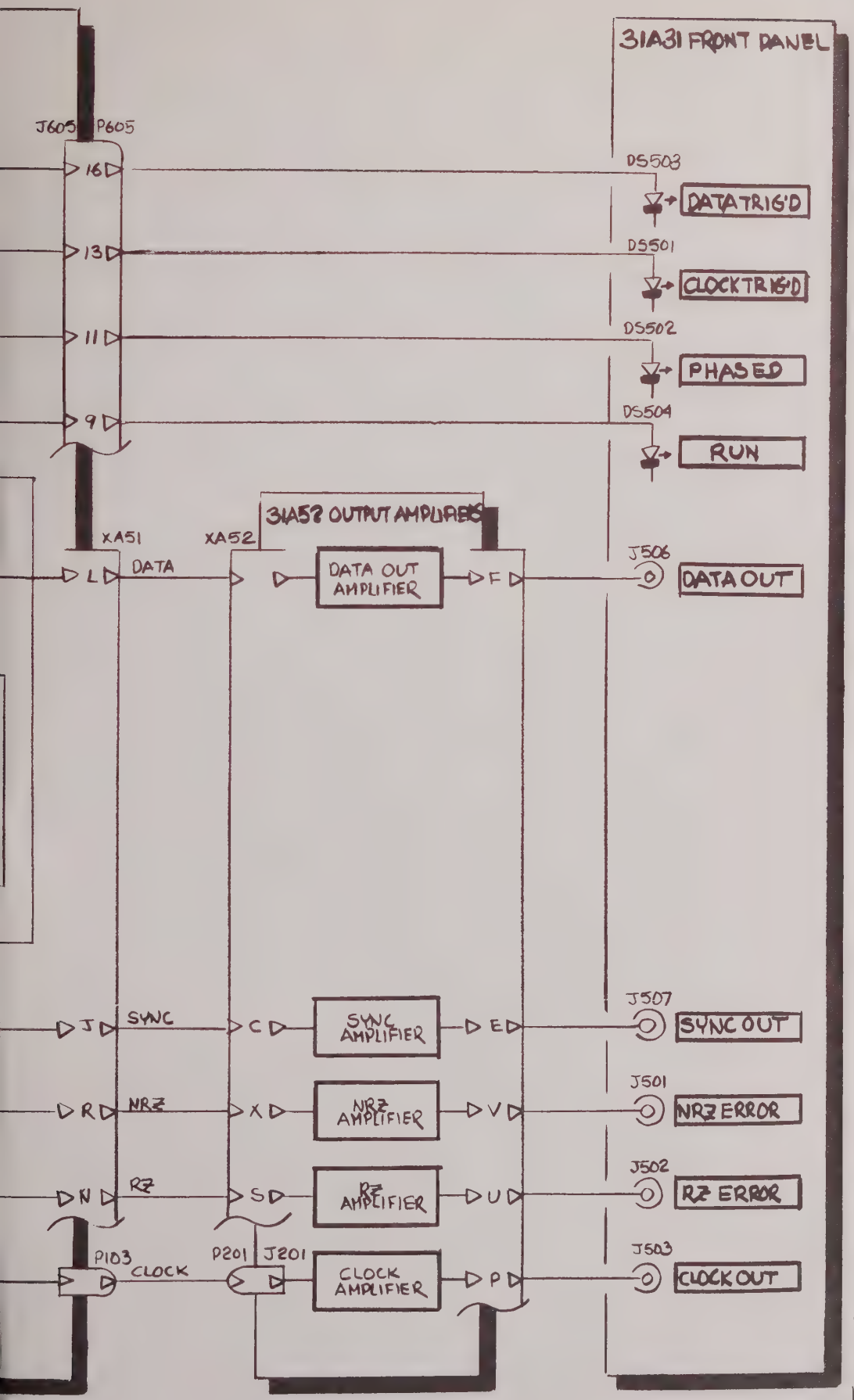
⊳— input
—⊳ output


31A31 FRONT PANEL
J504
CLOCK IN
S501
TEST
J505
DATA IN
Mode
S502
CODE LENGTH
S503

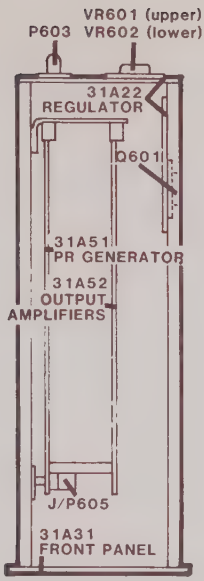



31A51 PR GENERATOR
J101
CLOCK INPUT
CLOCK DIST
CK1
CK2
CK4
J605
7
FEEDBACK
INPUT GATE
ENCODE
DECODE
J108
DATA INPUT
DATA LATCH
1
2 3 4 5
6 7
0
1


DATA STATUS
CLOCK STATUS
PHASE STATUS
RUN STATUS
CK5
CK6
CK7
CK8
DELTA SET
LAST SET
FEEDBACK GATE
ZERO DET
SYNC DET
RZ AND NRZ AMPLIFIER
CLOCK AMPLIFIER



Form 0154-0681C
TAU-TRON
MN-1
1 of 1 **BLOCK**



PARTS VALUES

Unless noted otherwise:

C in μF
L in μH
R in Ω
* special, see parts list

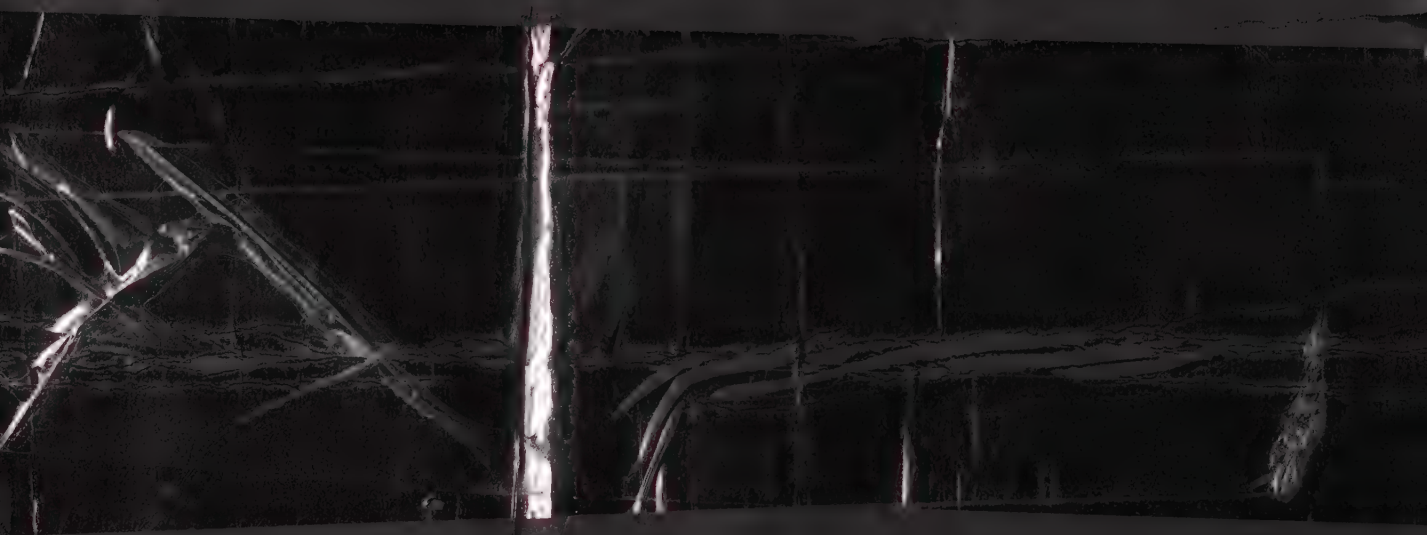
For full type numbers of ICs and transistors, see parts list

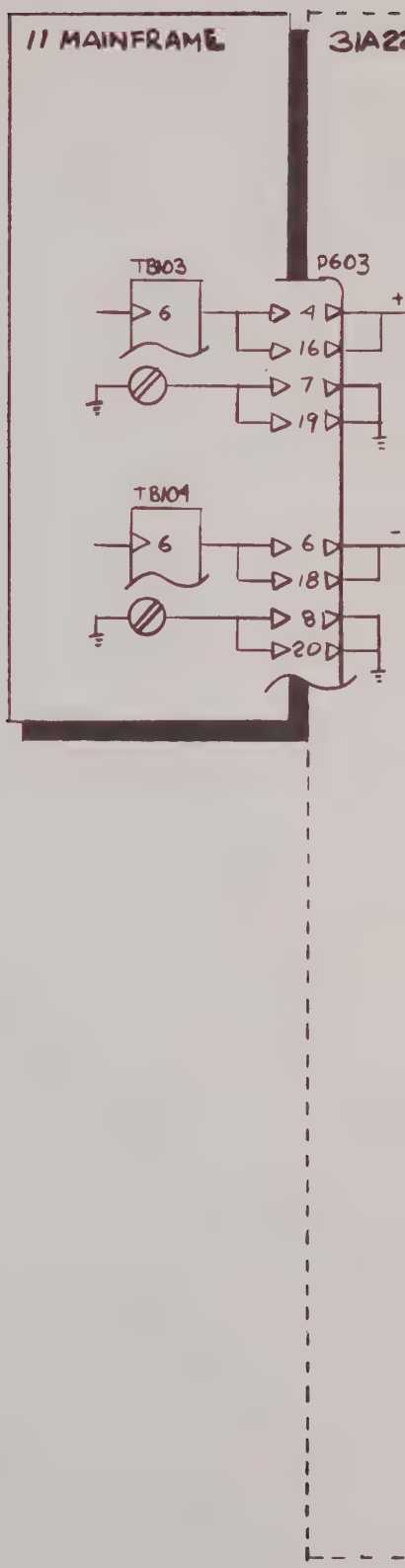
REFERENCE DESIGNATIONS

Full reference designations include assembly prefix

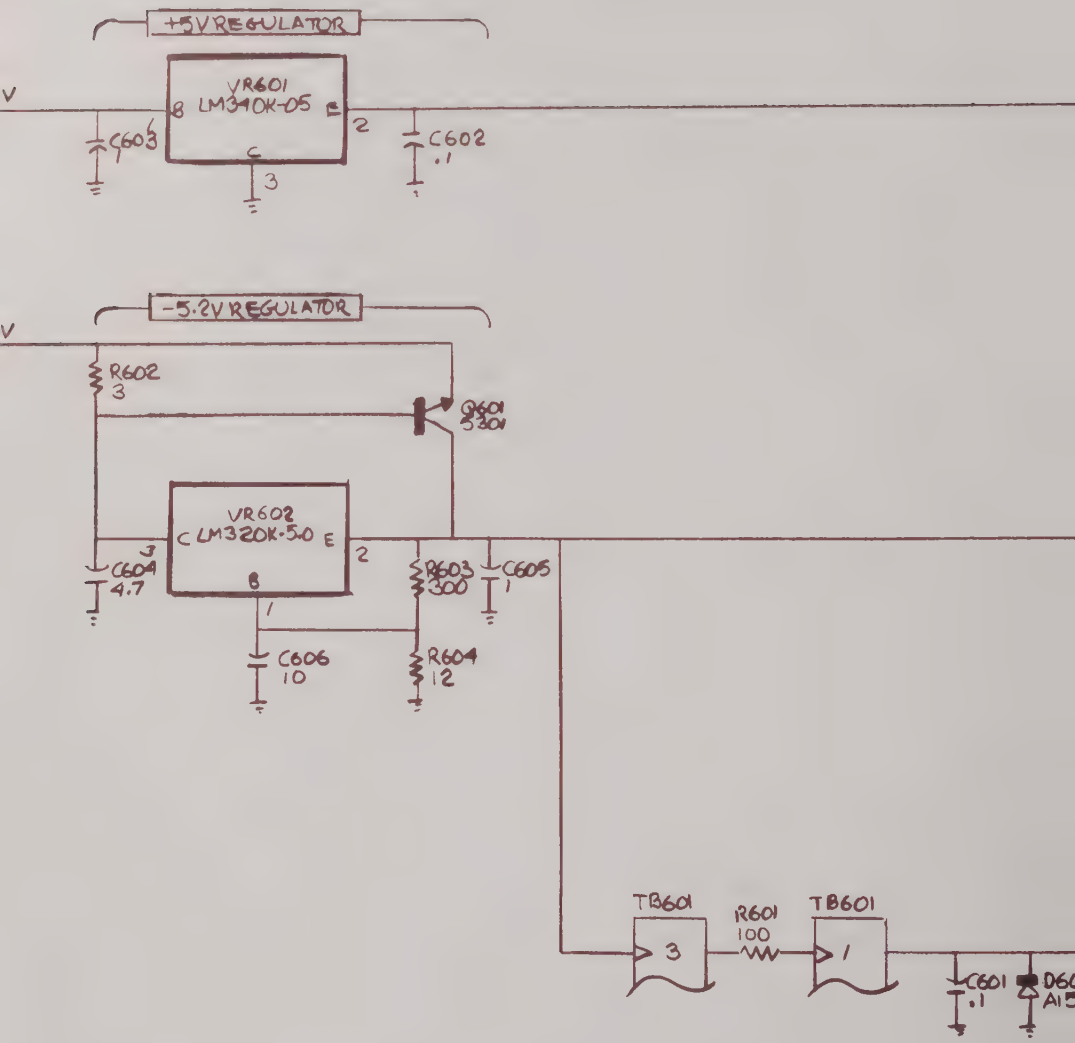
SIGNAL ORIGIN

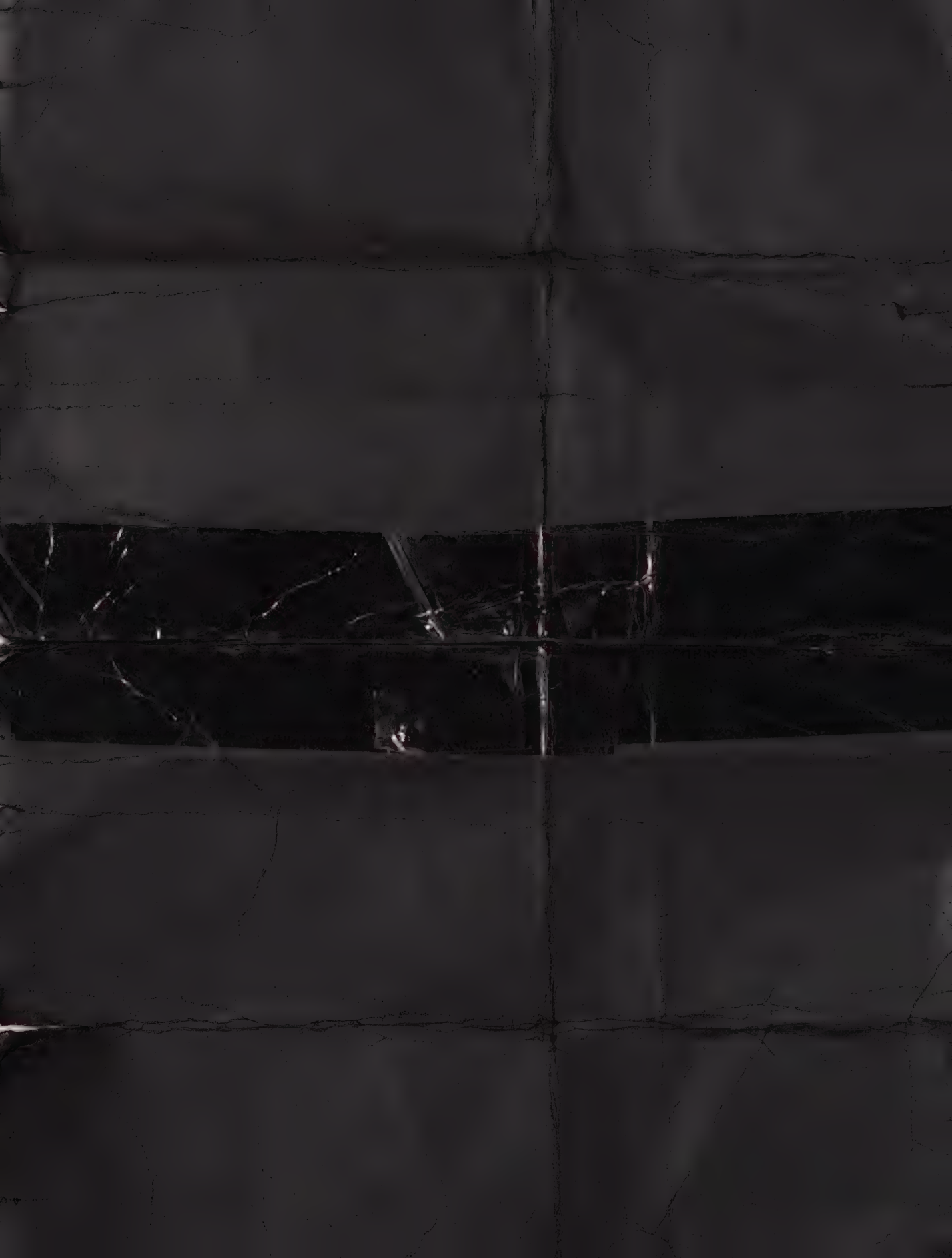
▷— input
—▷ output

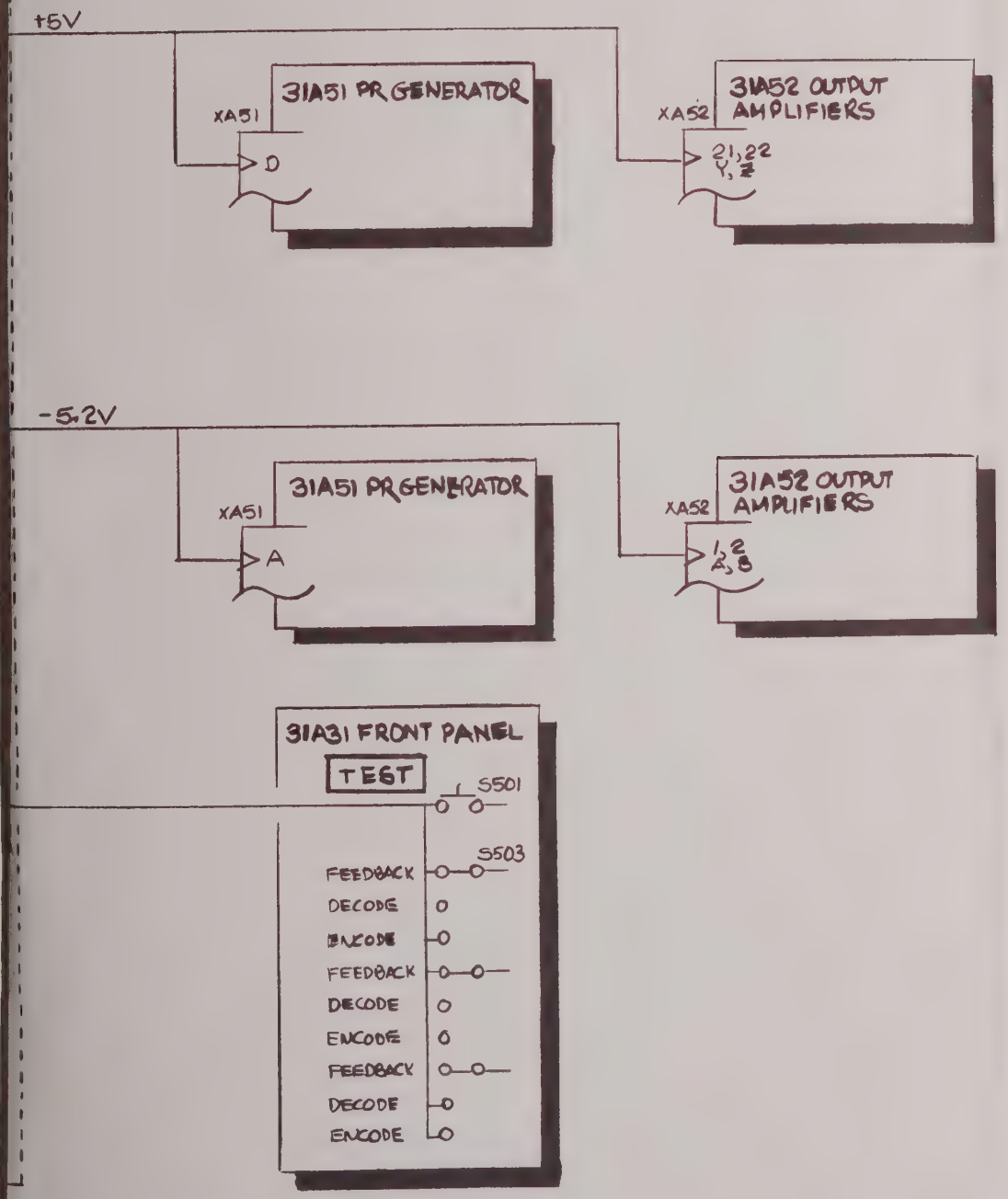



11 MAINFRAME
3IA2
TB03
P603
6
4
16
7
19
+
TB04
6
6
18
8
20
-

REGULATOR


+5V REGULATOR
VR601
LM340K-05
C603
C602
.1
-5.2V REGULATOR
R602
3
Q601
S301
VR602
LM320K-5.0
C604
4.7
R603
300
C605
1
C606
10
R604
12
TB601
3
R601
100
TB601
1
C601
.1

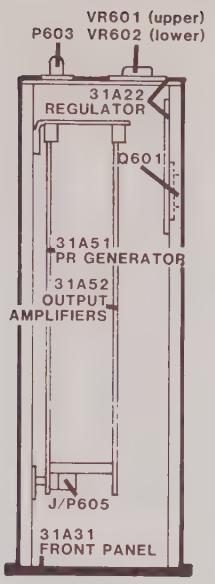


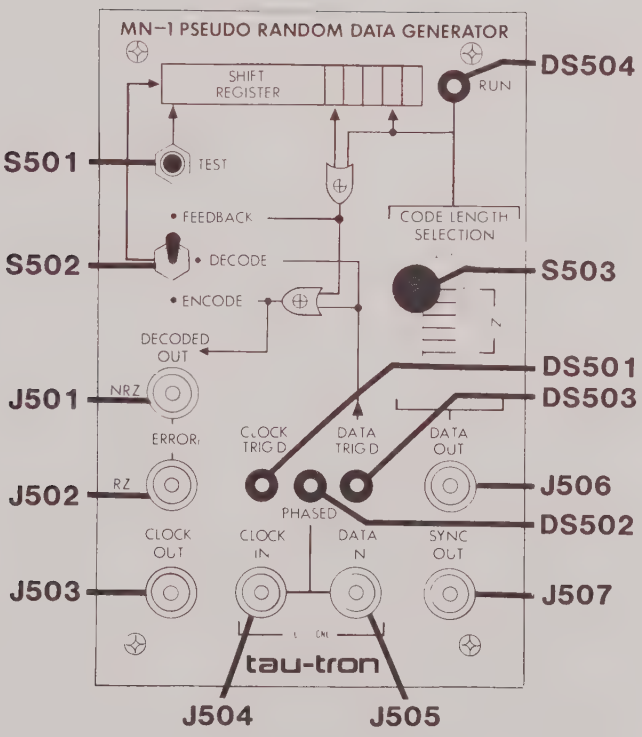


TAJ - 53383

Form 0154-0681C
TAU-TRON
MN-1

1 of 1 **31A22**
REGULATOR





PARTS VALUES

Unless noted otherwise:

C in μF
L in μH
R in Ω
* special, see parts list

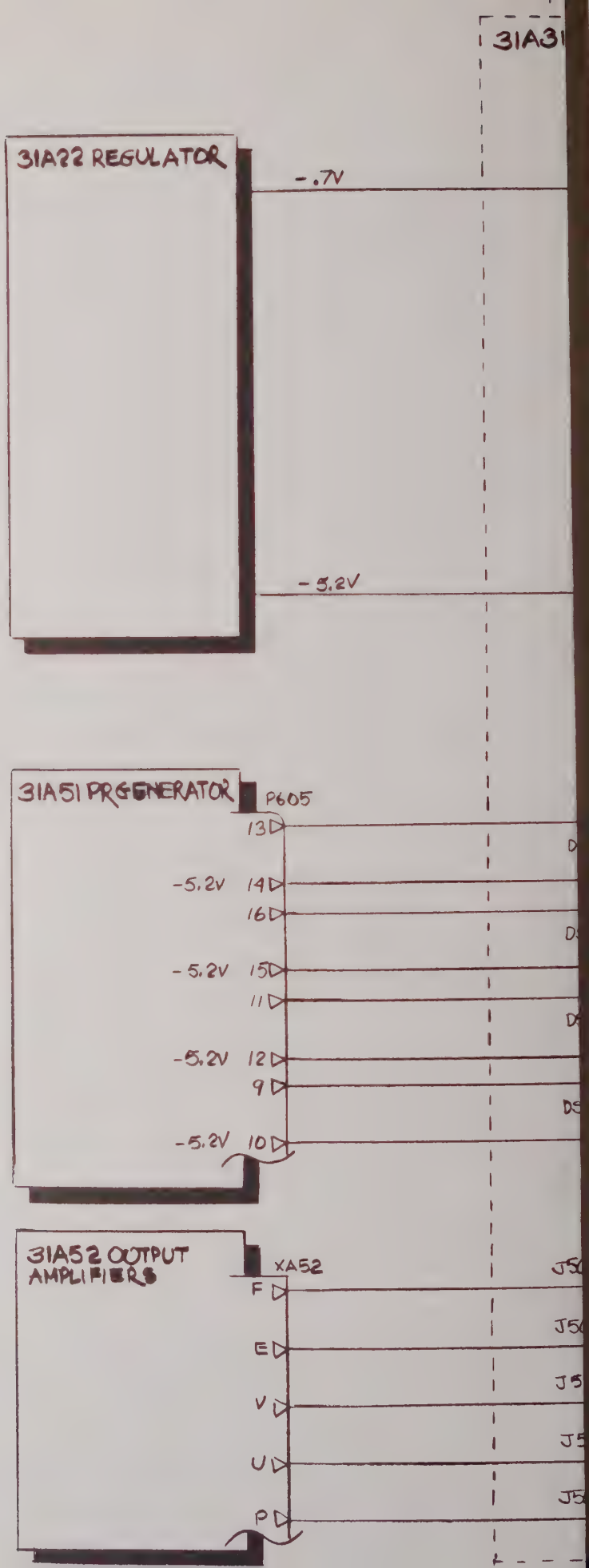
For full type numbers of ICs and transistors, see parts list

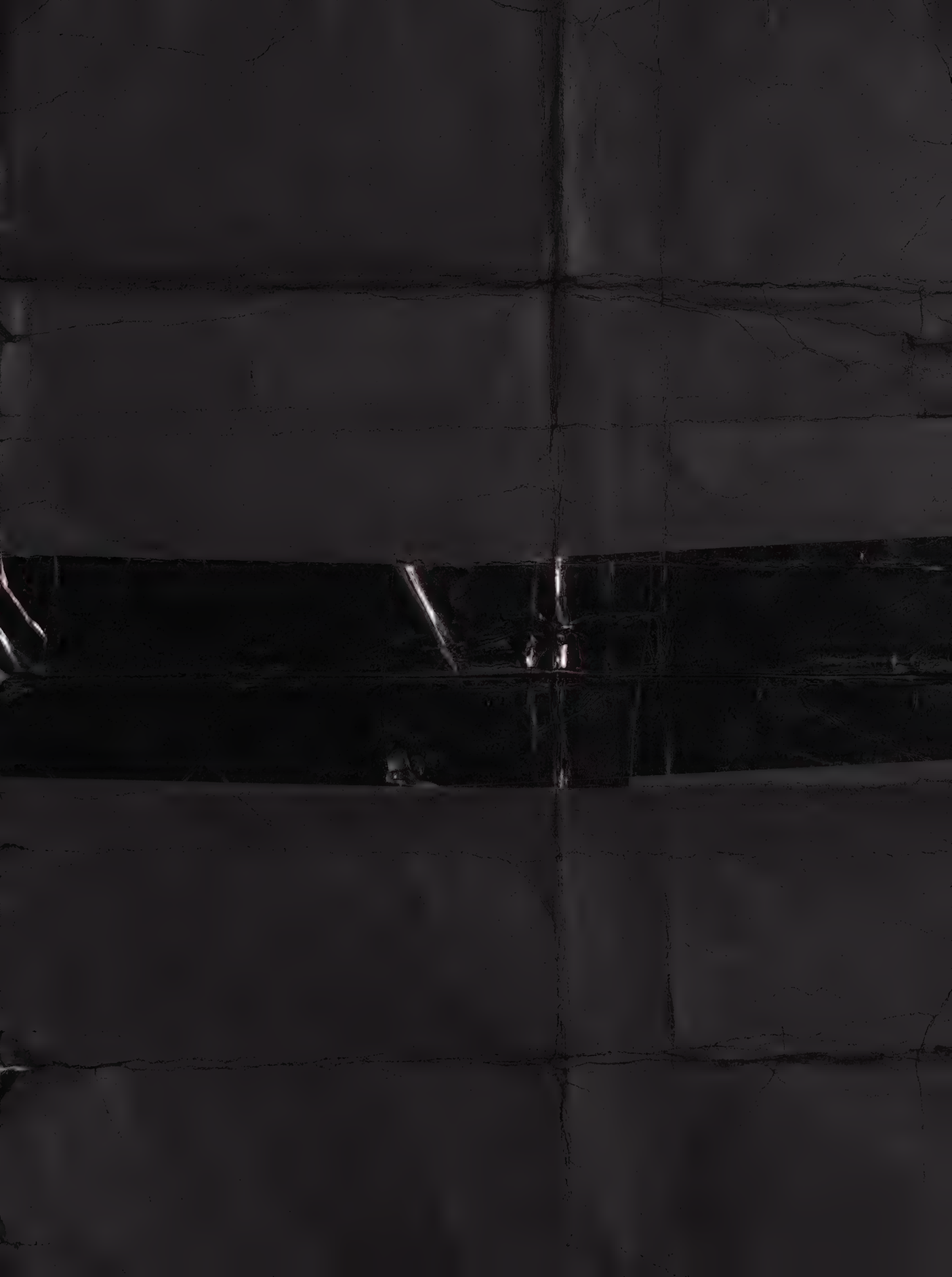
REFERENCE DESIGNATIONS

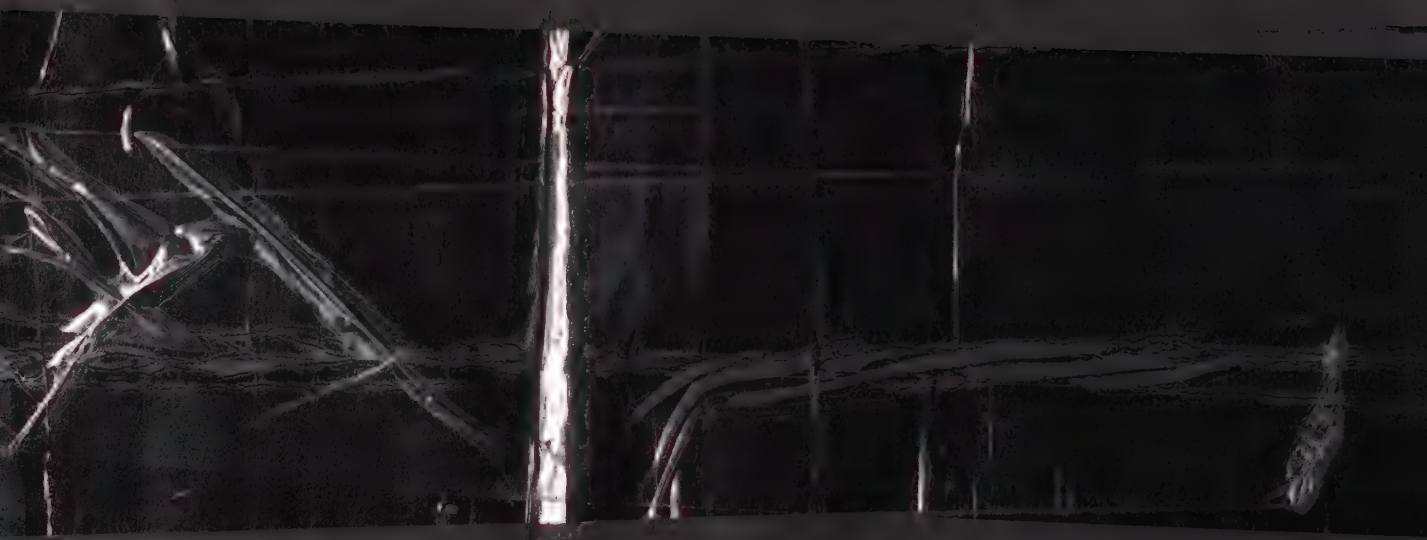
Full reference designations include assembly prefix

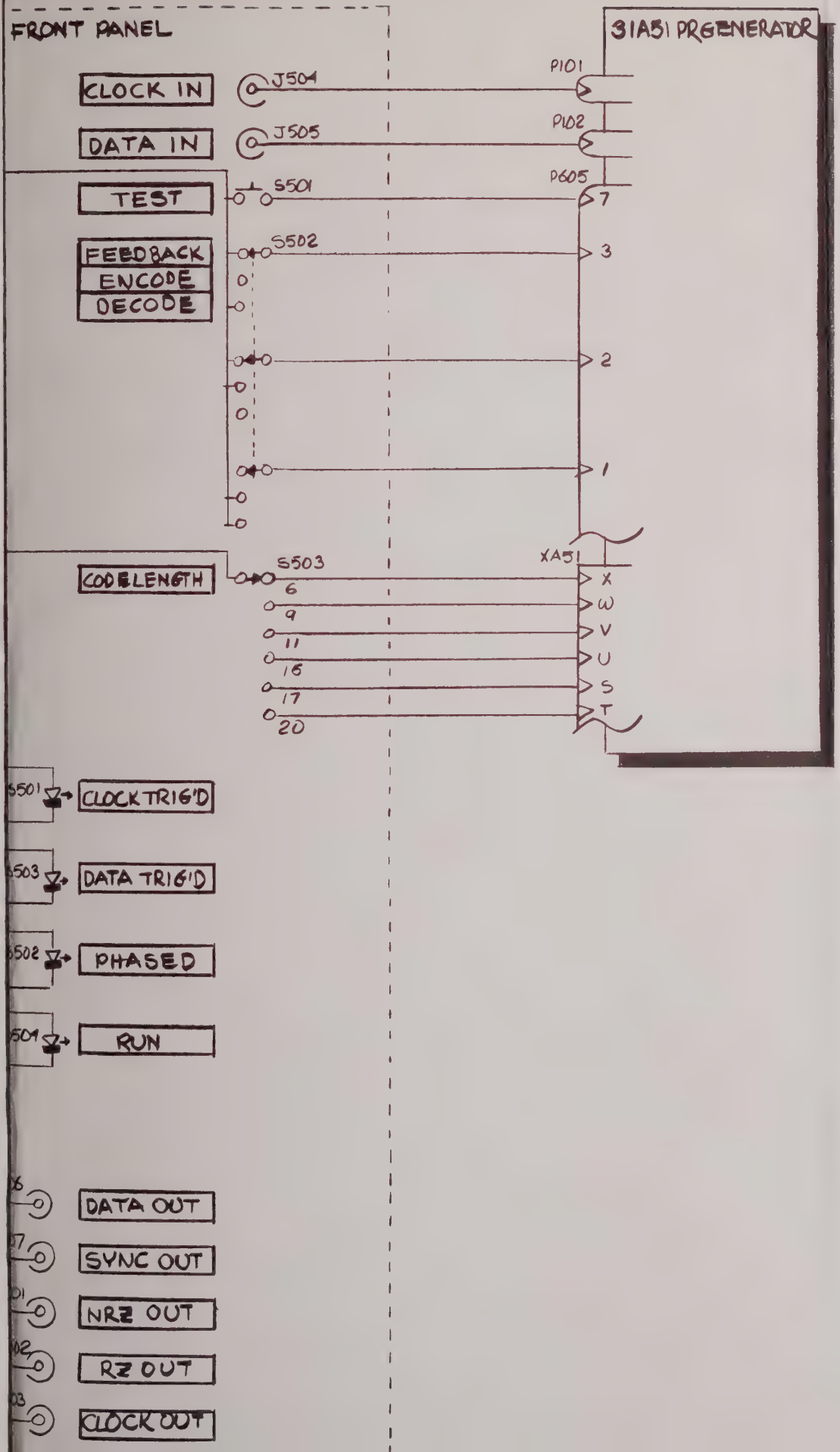
SIGNAL ORIGIN

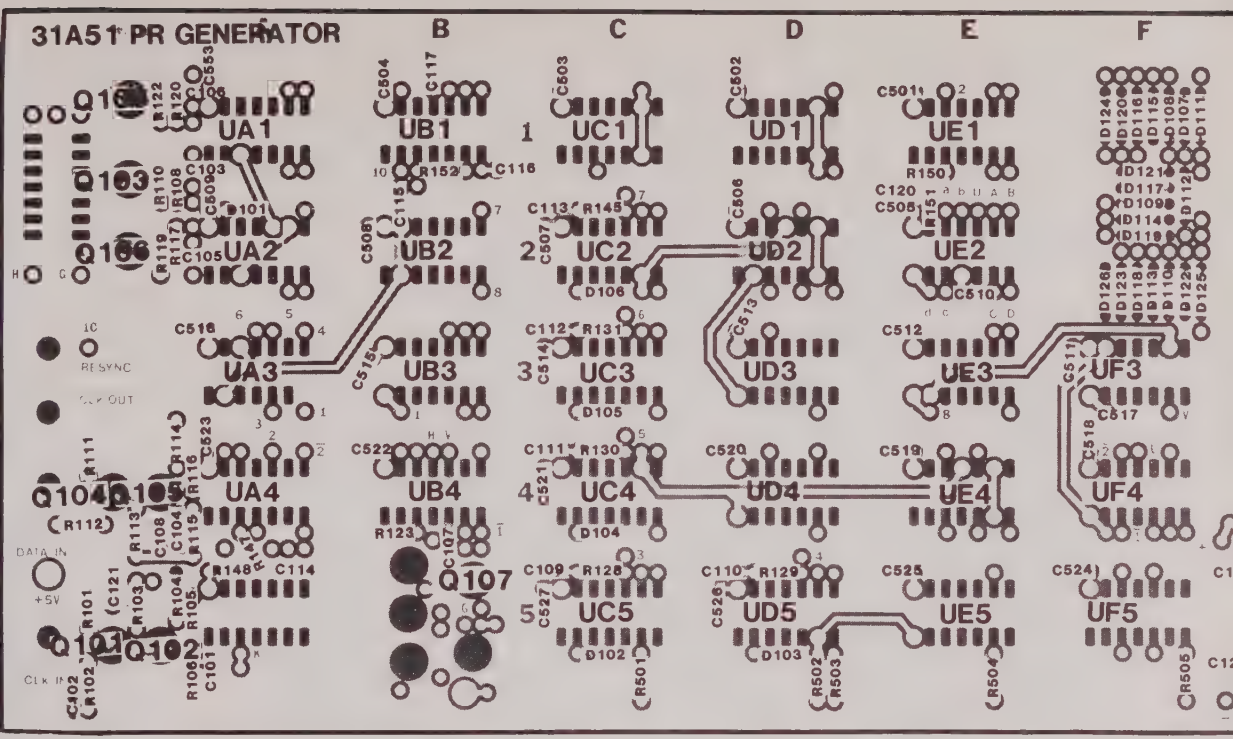
⊳— input
—⊳ output

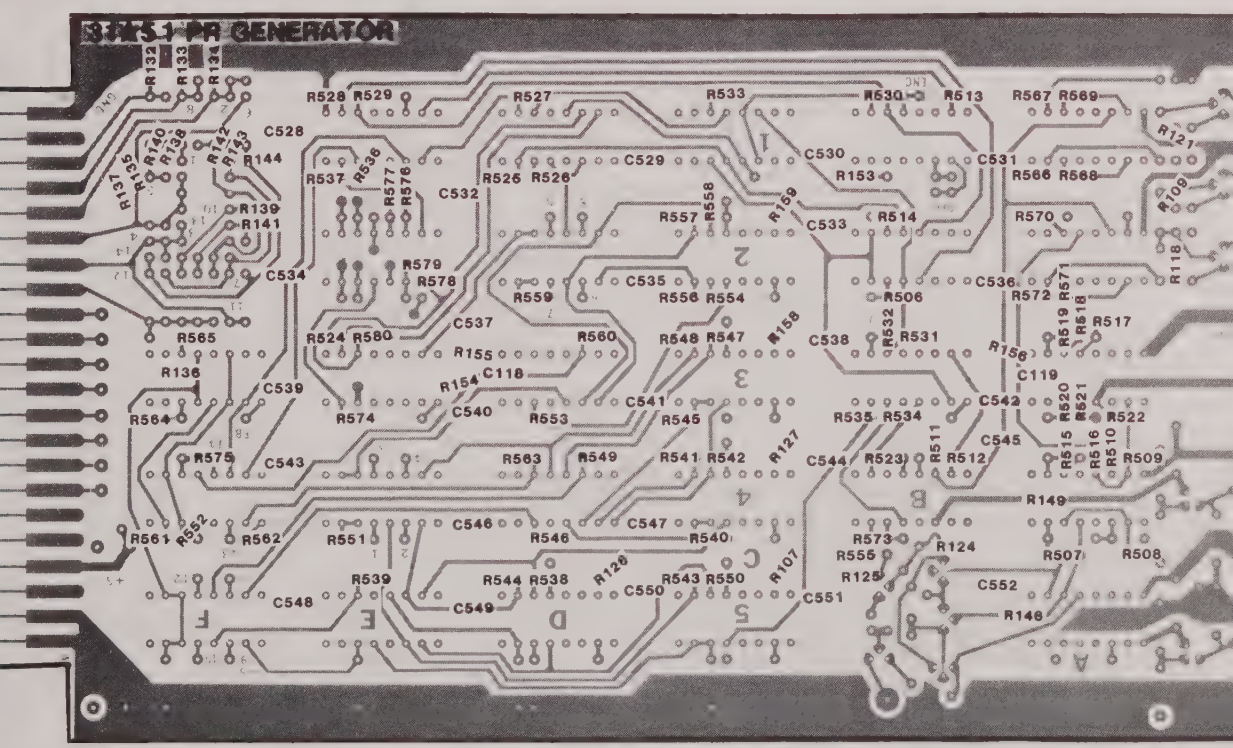

31A31
31A22 REGULATOR
-.7V
-5.2V
31A51 PRGENERATOR
P605
13
-5.2V 14
16
-5.2V 15
11
-5.2V 12
9
-5.2V 10
31A52 OUTPUT AMPLIFIERS
XA52
F
E
V
U
P

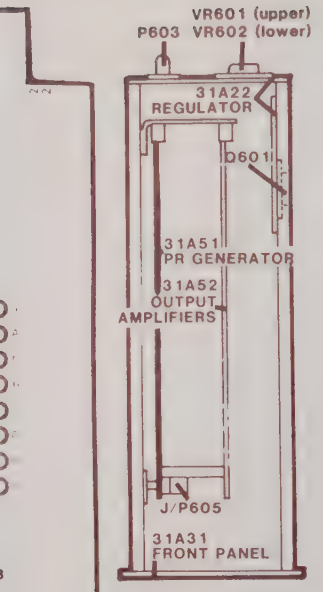





FRONT PANEL
31A51 PRGENERATOR
CLOCK IN
J504
P101
DATA IN
J505
P102
P605
TEST
S501
7
FEEDBACK
ENCODE
DECODE
S502
3
2
1
XA51
CODELENGTH
S503
6
9
11
16
17
20
X
W
V
U
S
T
S501
CLOCK TRIG'D
S503
DATA TRIG'D
S502
PHASED
S501
RUN
06
DATA OUT
07
SYNC OUT
01
NRZ OUT
02
RZ OUT
03
CLOCK OUT


31A51 PR GENERATOR
A
B
C
D
E
F
UA1
UA2
UA3
UA4
UB1
UB2
UB3
UB4
UC1
UC2
UC3
UC4
UC5
UD1
UD2
UD3
UD4
UD5
UE1
UE2
UE3
UE4
UE5
UF3
UF4
UF5
Q103
Q104
Q105
Q106
Q107
Q101
Q102
RESYNC
DATA IN
+5V
CLK IN


31A51 PR GENERATOR



IC SIDE

NON-IC SIDE

PARTS VALUES

Unless noted otherwise

C in μF
L in μH
R in Ω
* special, see parts list

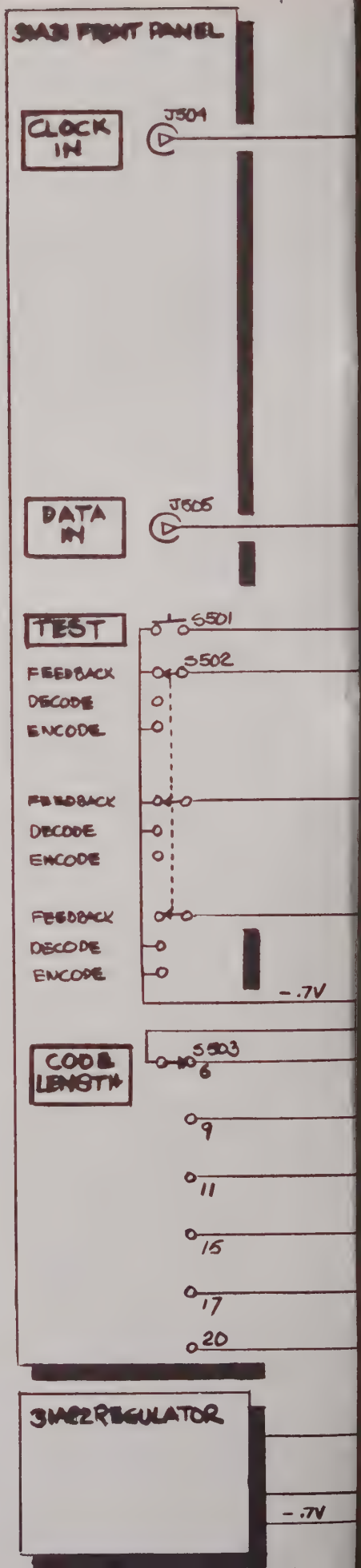
For full type numbers of ICs and transistors, see parts list

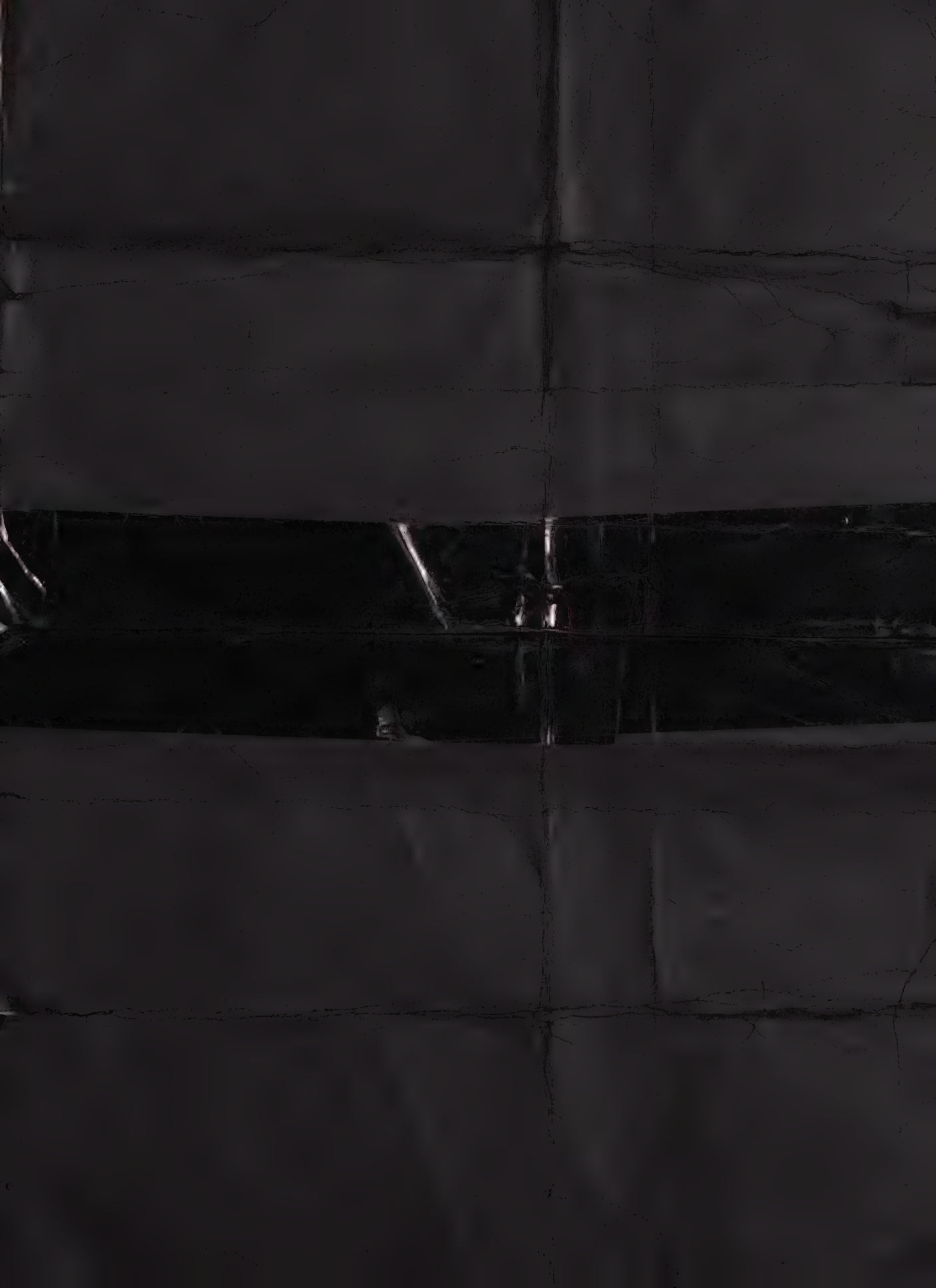
REFERENCE DESIGNATIONS

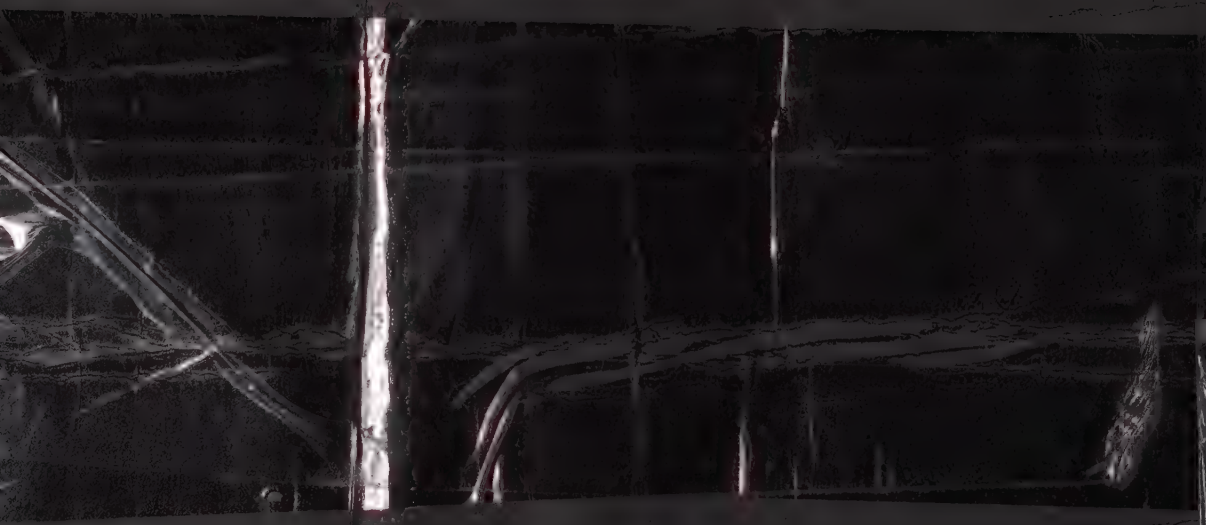
Full reference designations include assembly prefix

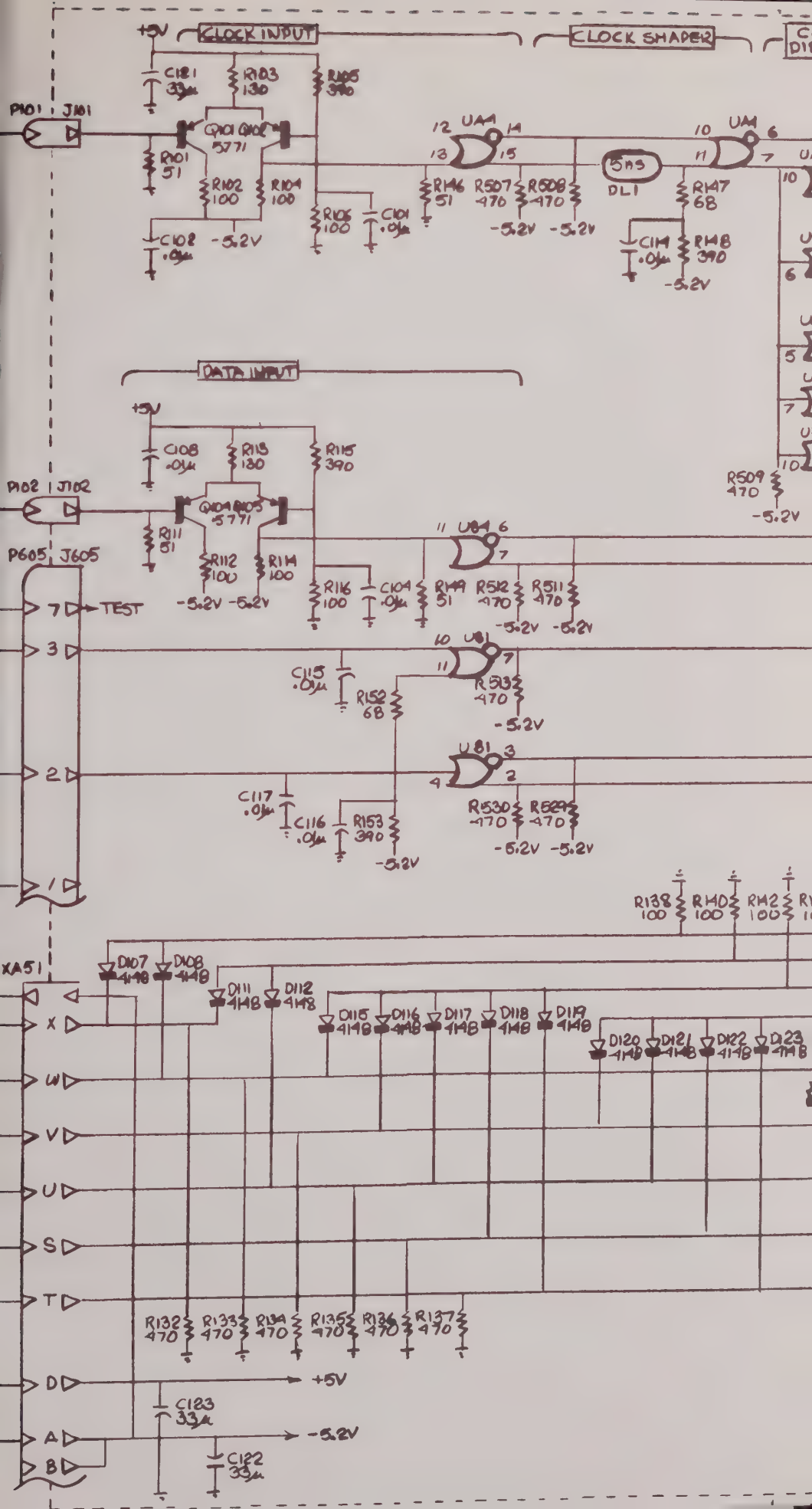
SIGNAL ORIGIN

▷— input
—▷ output

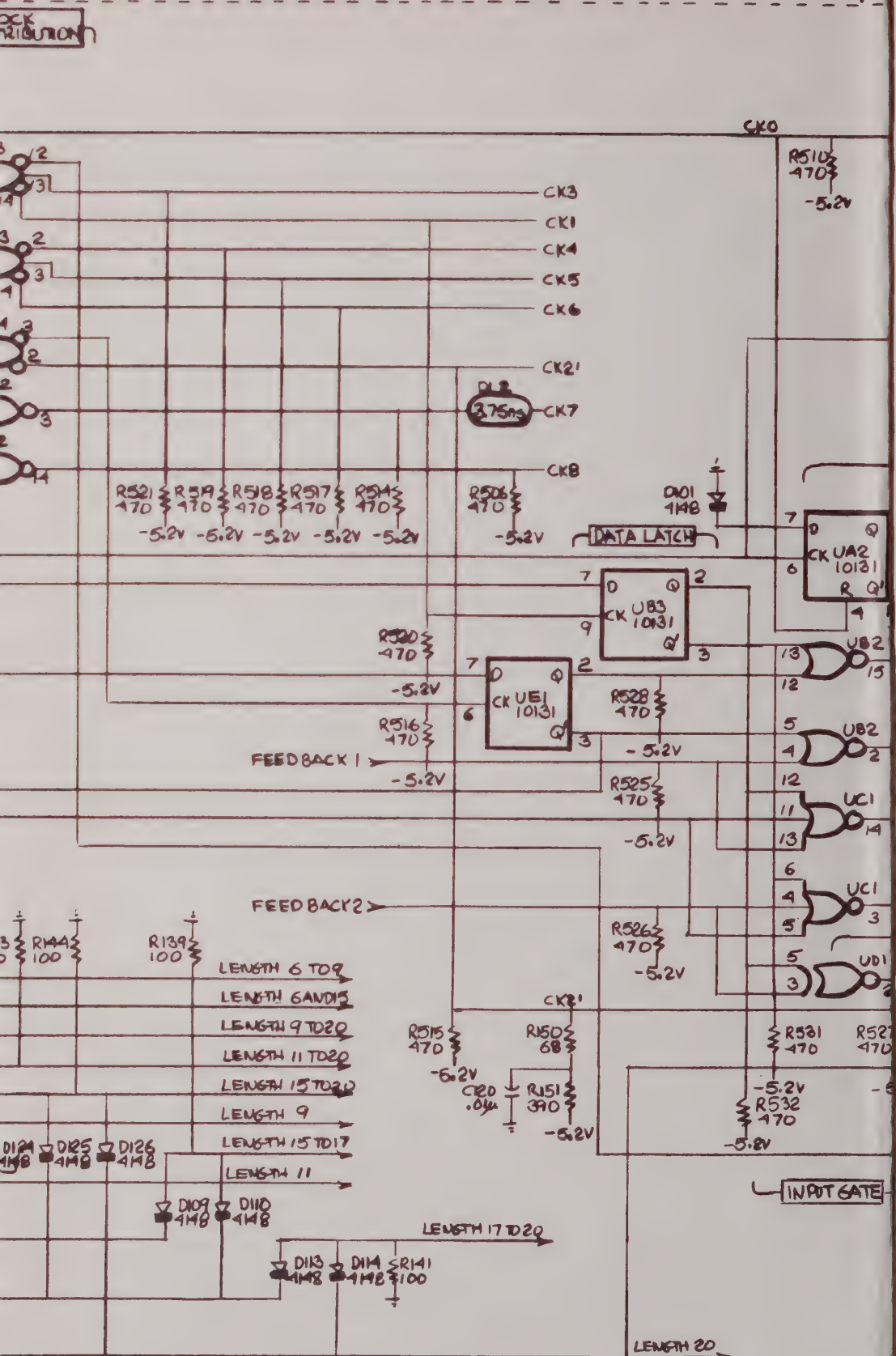


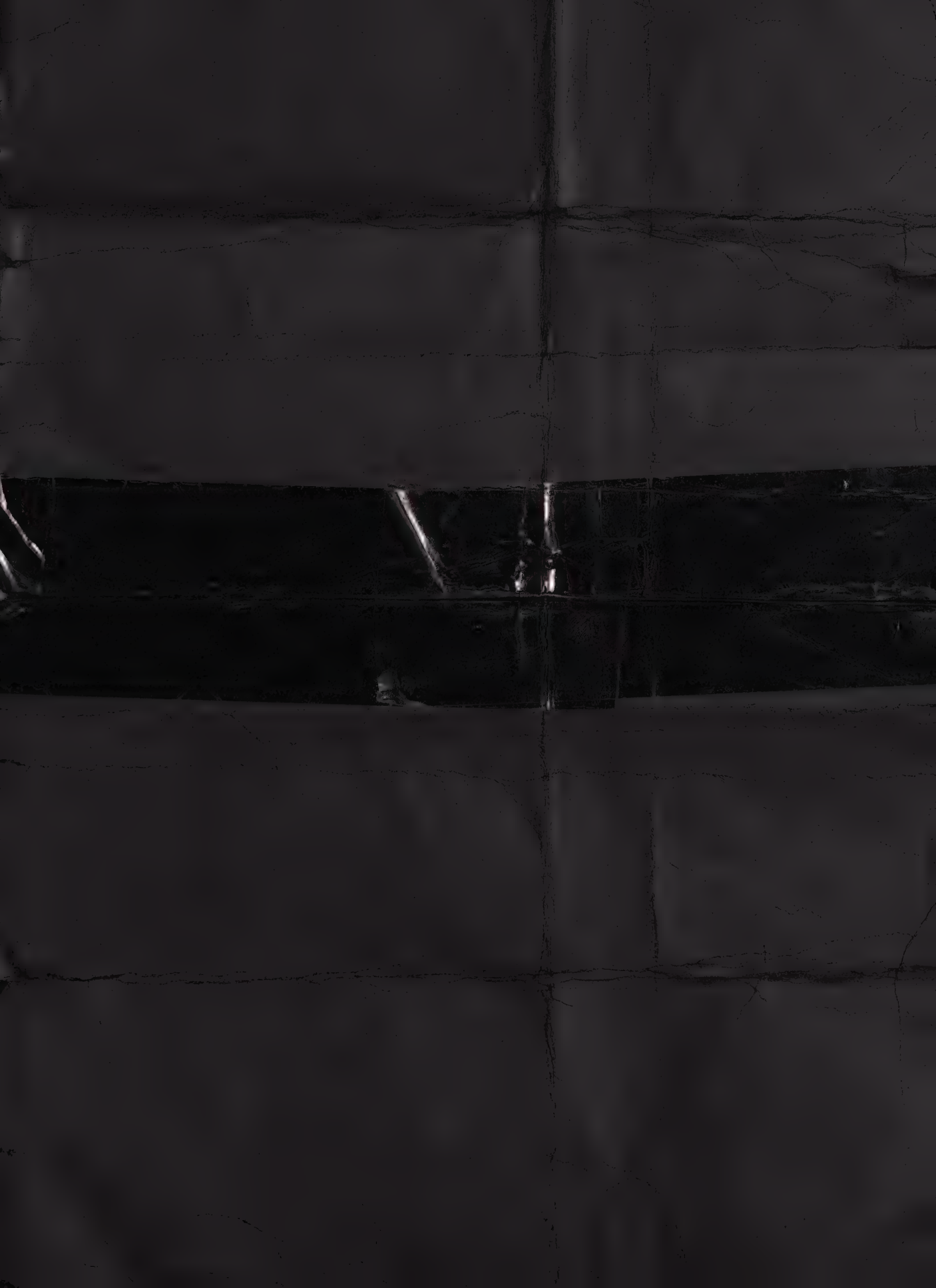


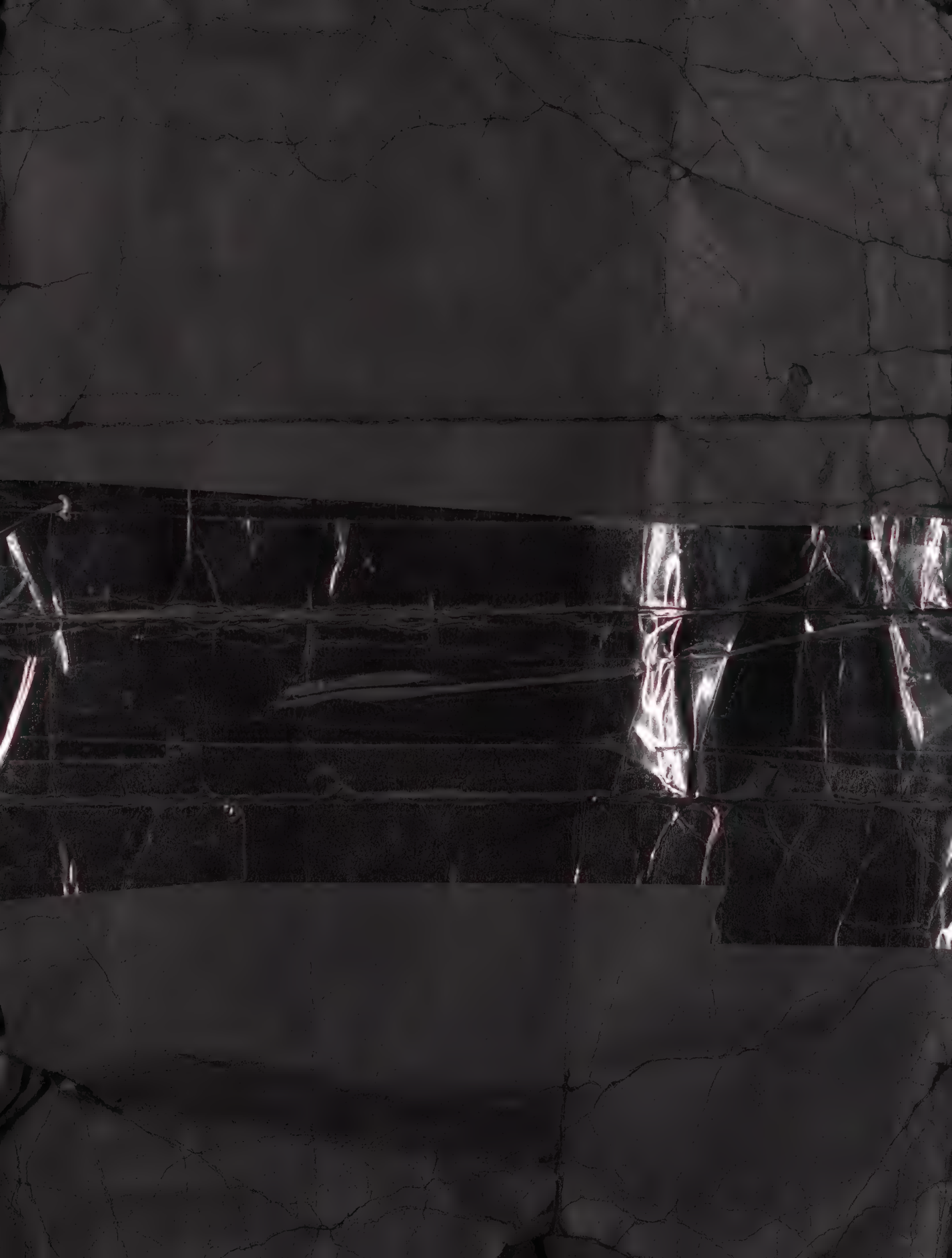


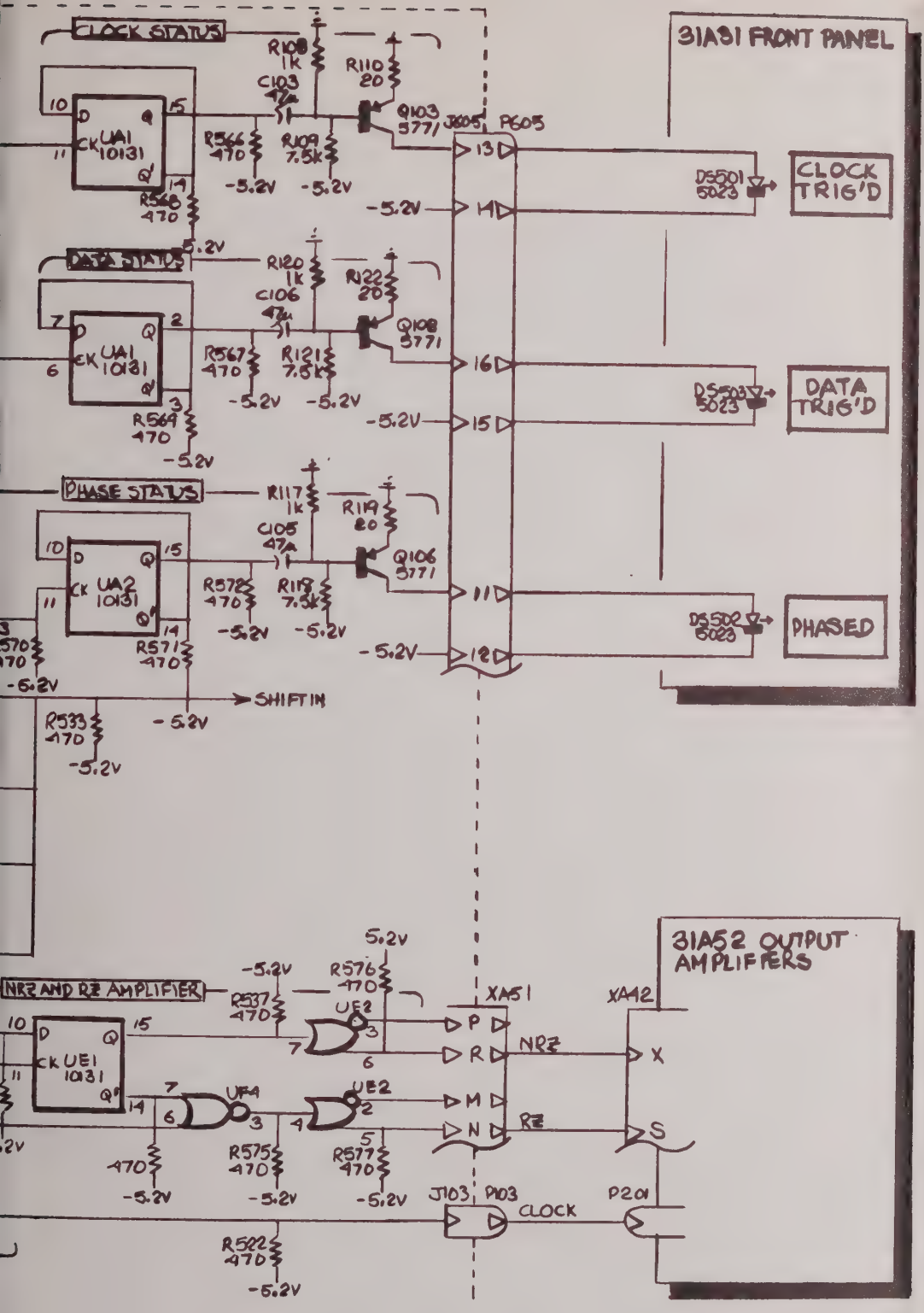


CLOCK INPUT
CLOCK SHAPER
DATA INPUT
+5V
-5.2V
P101 J101
P102 J102
P605 J605
TEST
XA51
C121 33μ
R103 130
R105 390
Q101 Q102 5771
R101 51
R102 100
R104 100
C102 .01μ
R106 100
C101 .01μ
UA4
R146 51
R507 470
R508 470
5ns DL1
R147 68
C114 .01μ
R148 390
R509 470
C108 .01μ
R113 130
R115 390
Q104 Q105 5771
R111 51
R112 100
R114 100
R116 100
C104 .01μ
U84
R149 51
R512 470
R511 470
U81
C115 .01μ
R152 68
R513 470
C117 .01μ
C116 .01μ
R153 390
R530 470
R529 470
R138 100
R140 100
R142 100
D107 4148
D108 4148
D111 4148
D112 4148
D115 4148
D116 4148
D117 4148
D118 4148
D119 4148
D120 4148
D121 4148
D122 4148
D123 4148
R132 470
R133 470
R134 470
R135 470
R136 470
R137 470
C123 33μ
C122 33μ


CK0
CK3
CK1
CK4
CK5
CK6
CK2
CK7
CK8
DL8
375ns
R510 470 -5.2V
R521 470 -5.2V
R519 470 -5.2V
R518 470 -5.2V
R517 470 -5.2V
R514 470 -5.2V
R506 470 -5.2V
D101 1N48
DATA LATCH
UA2 10131
UB3 10131
UE1 10131
UB2
UC1
UD1
R520 470 -5.2V
R516 470 -5.2V
FEEDBACK 1
R528 470 -5.2V
R525 470 -5.2V
FEEDBACK 2
R526 470 -5.2V
R144 100
R139 100
LENGTH 6 TO 9
LENGTH 6 AND 15
LENGTH 9 TO 20
LENGTH 11 TO 20
LENGTH 15 TO 20
LENGTH 9
LENGTH 15 TO 17
LENGTH 11
LENGTH 17 TO 20
LENGTH 20
D124 1N48
D125 1N48
D126 1N48
D109 1N48
D110 1N48
D113 1N48
D114 1N48
R141 100
CK21
R515 470 -5.2V
R150 68
C120 .01μ
R151 390 -5.2V
R531 470
R532 470 -5.2V
INPUT GATE



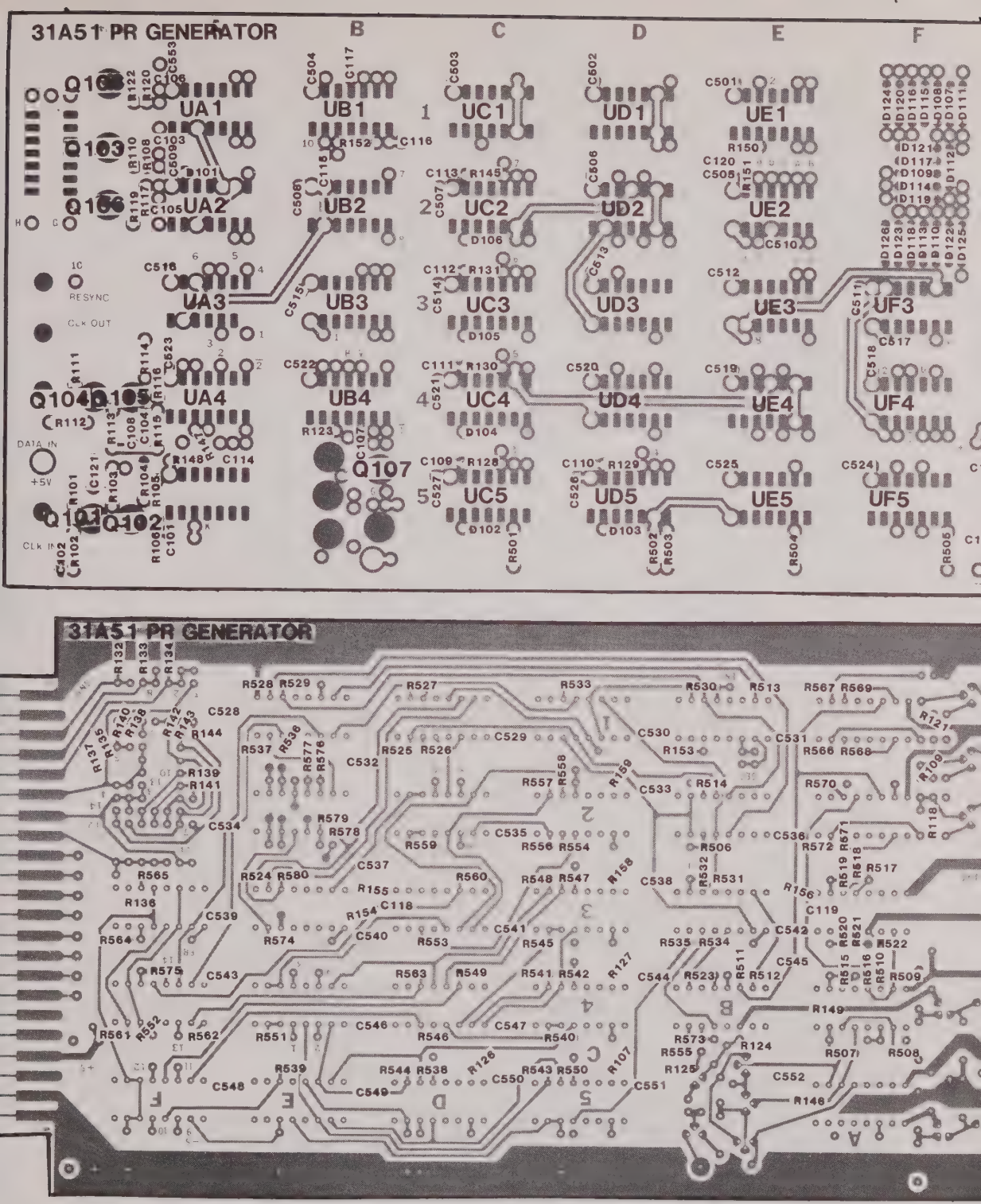




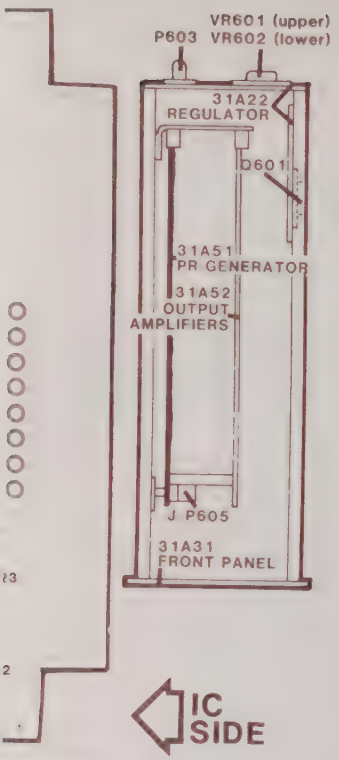
TDJ-53234
REV 4

Form 0154-0681C
TAU - TRON
MN-1

1 of 2 **31A51**
PR GENERATOR


31A51 PR GENERATOR
B
C
D
E
F
UA1
UA2
UA3
UA4
UB1
UB2
UB3
UB4
UC1
UC2
UC3
UC4
UC5
UD1
UD2
UD3
UD4
UD5
UE1
UE2
UE3
UE4
UE5
UF3
UF4
UF5
Q103
Q104
Q105
Q106
Q107
Q101
Q102
RESYNC
Clk OUT
DATA IN
+5V
CLK IN

31A51 PR GENERATOR



IC SIDE

NON-IC SIDE

PARTS VALUES

Unless noted otherwise:

C in μF
L in μH
R in Ω
* special, see parts list

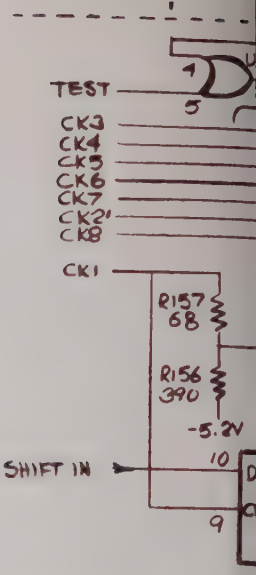
For full type numbers of ICs and transistors, see parts list

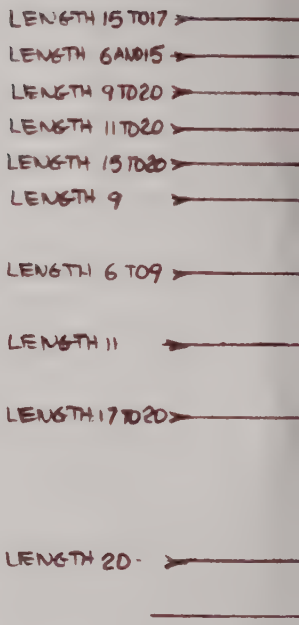
REFERENCE DESIGNATIONS

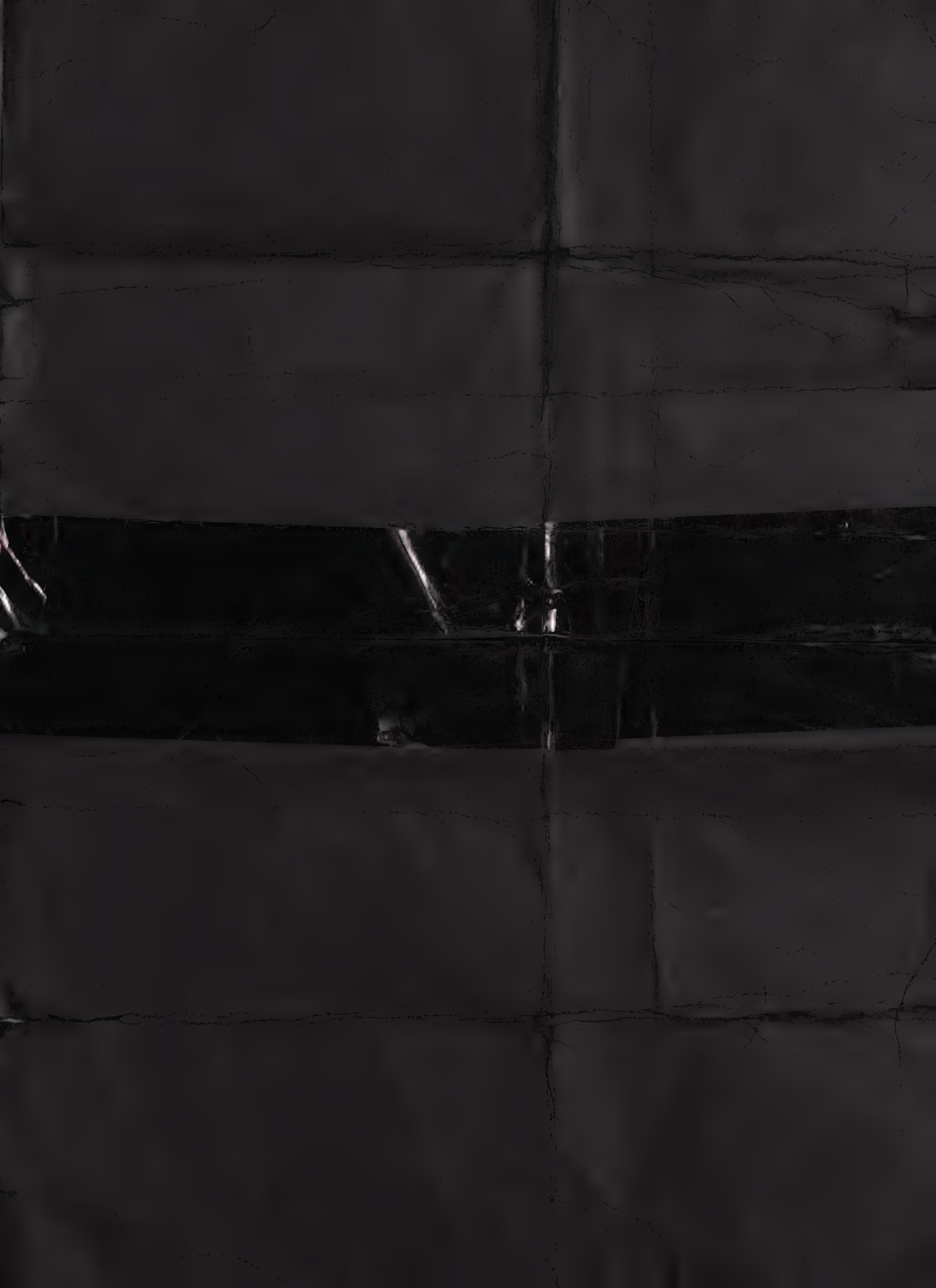
Full reference designations include assembly prefix

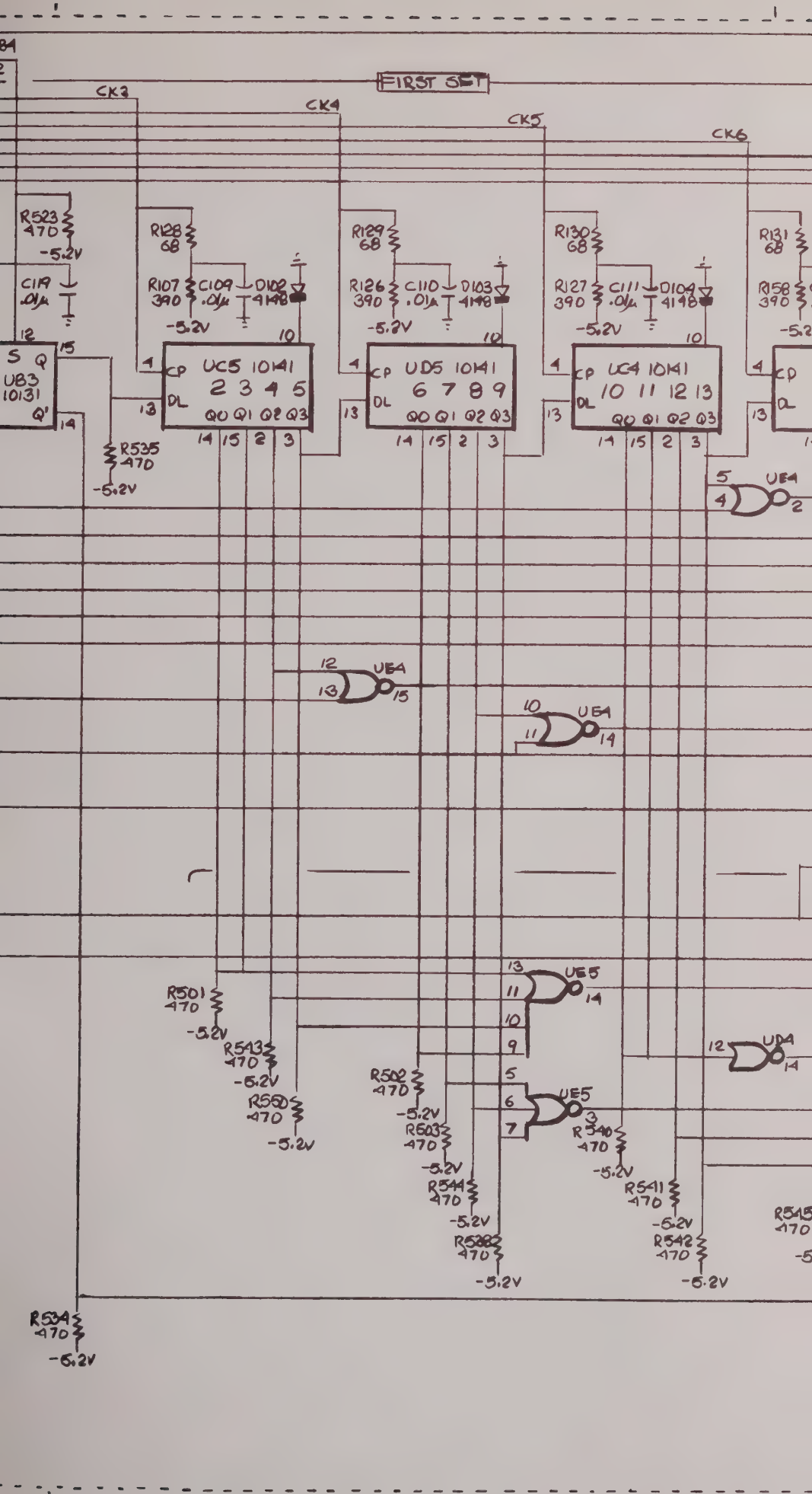
SIGNAL ORIGIN

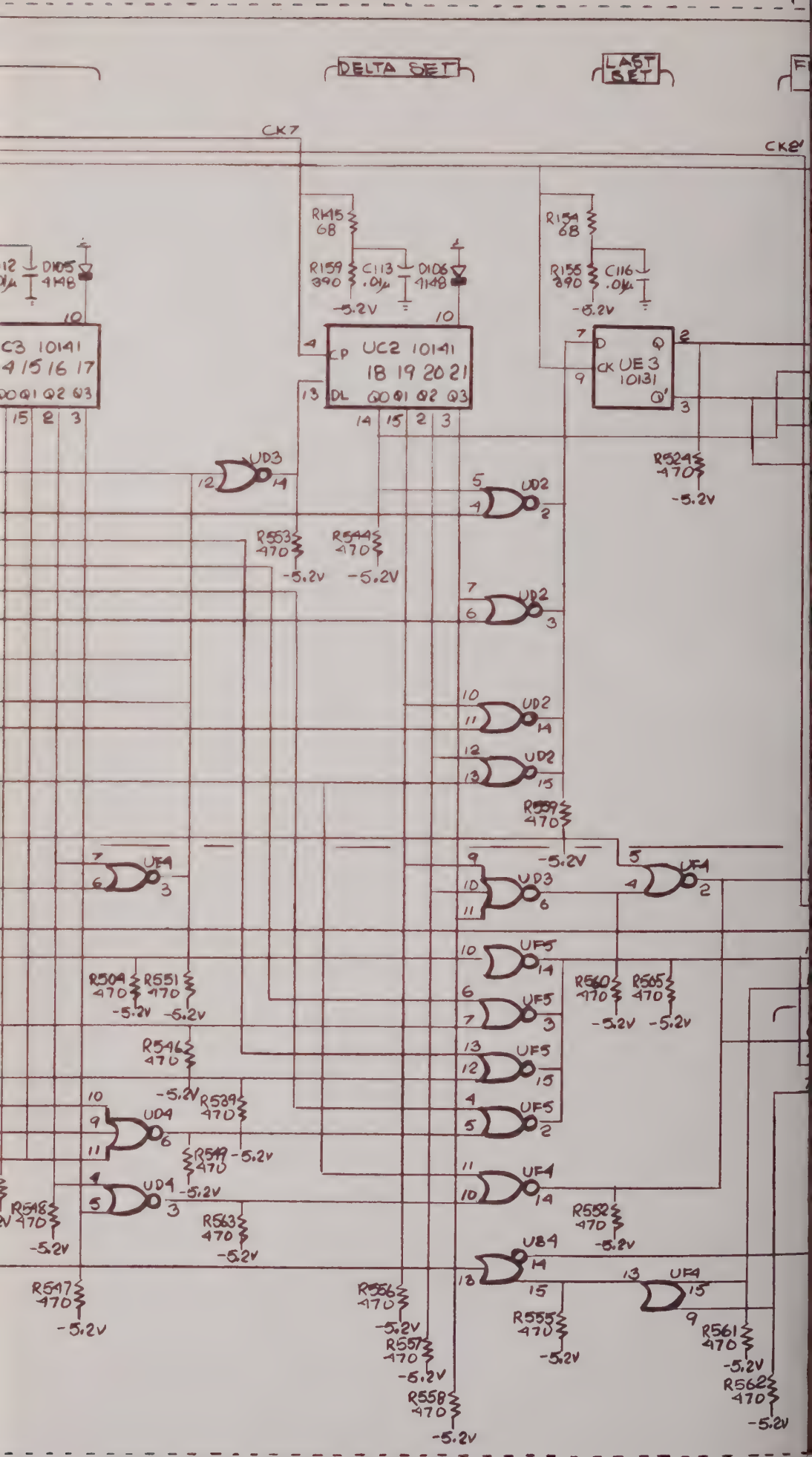
▷— input
—▷ output

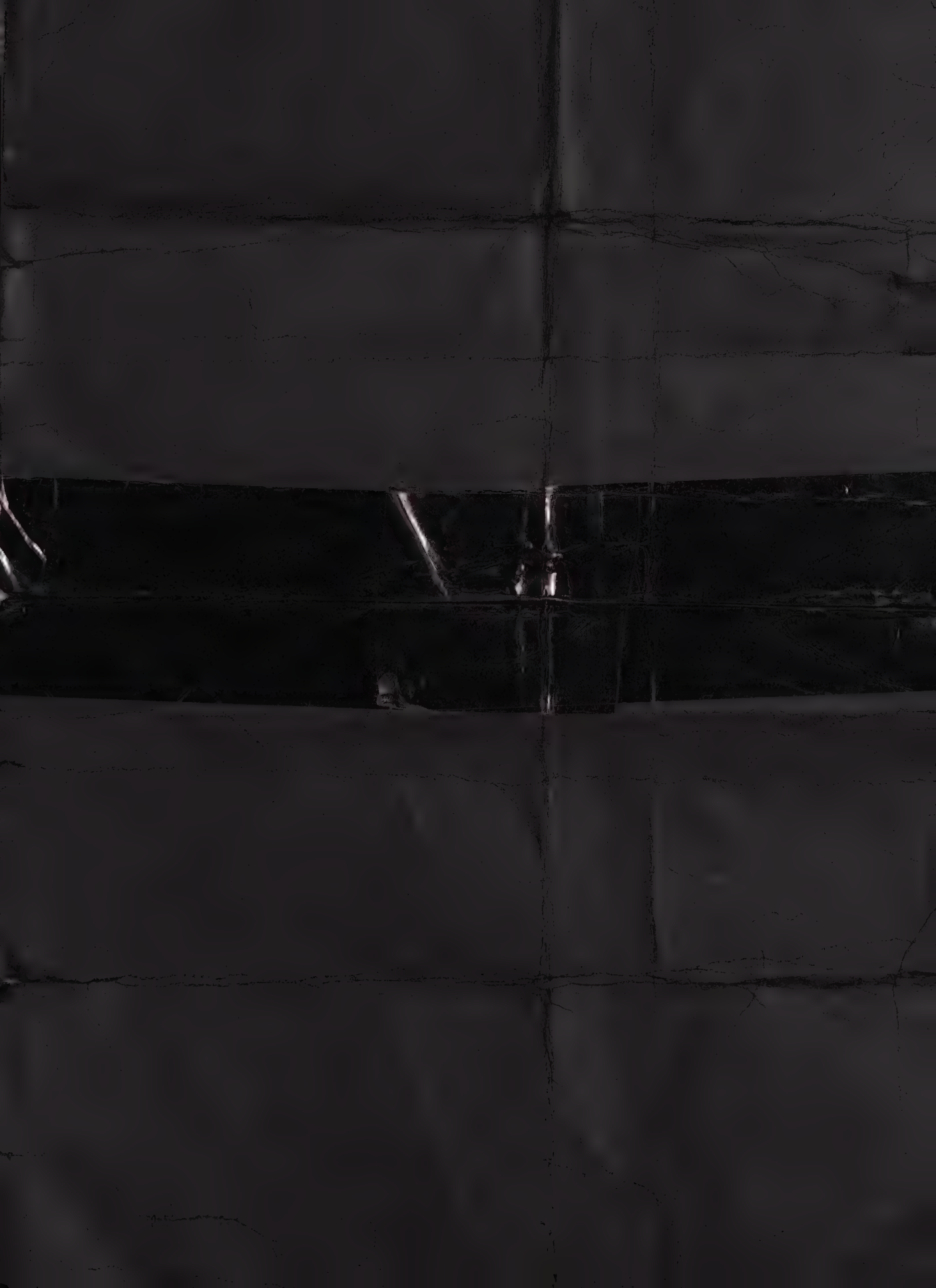


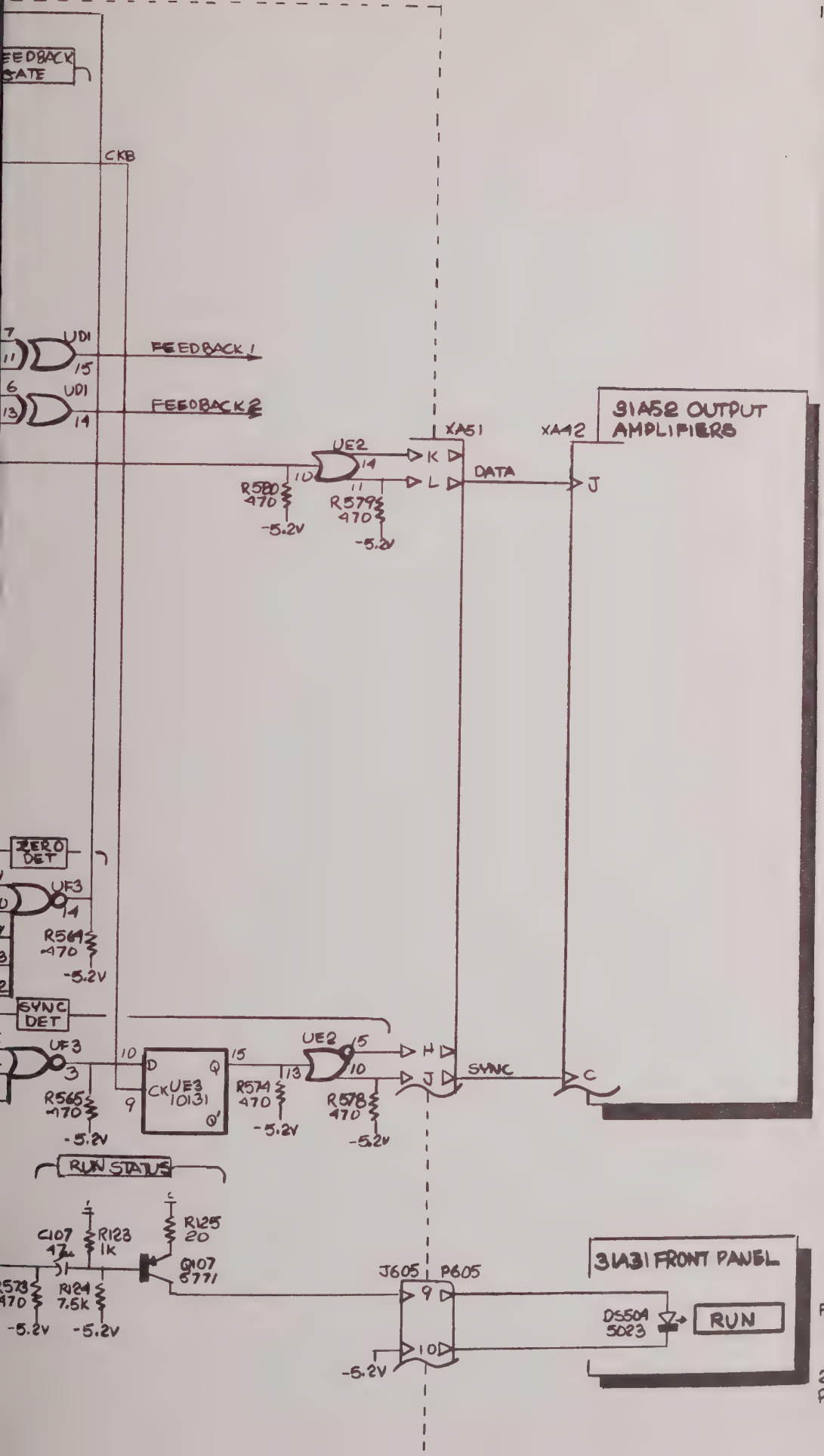




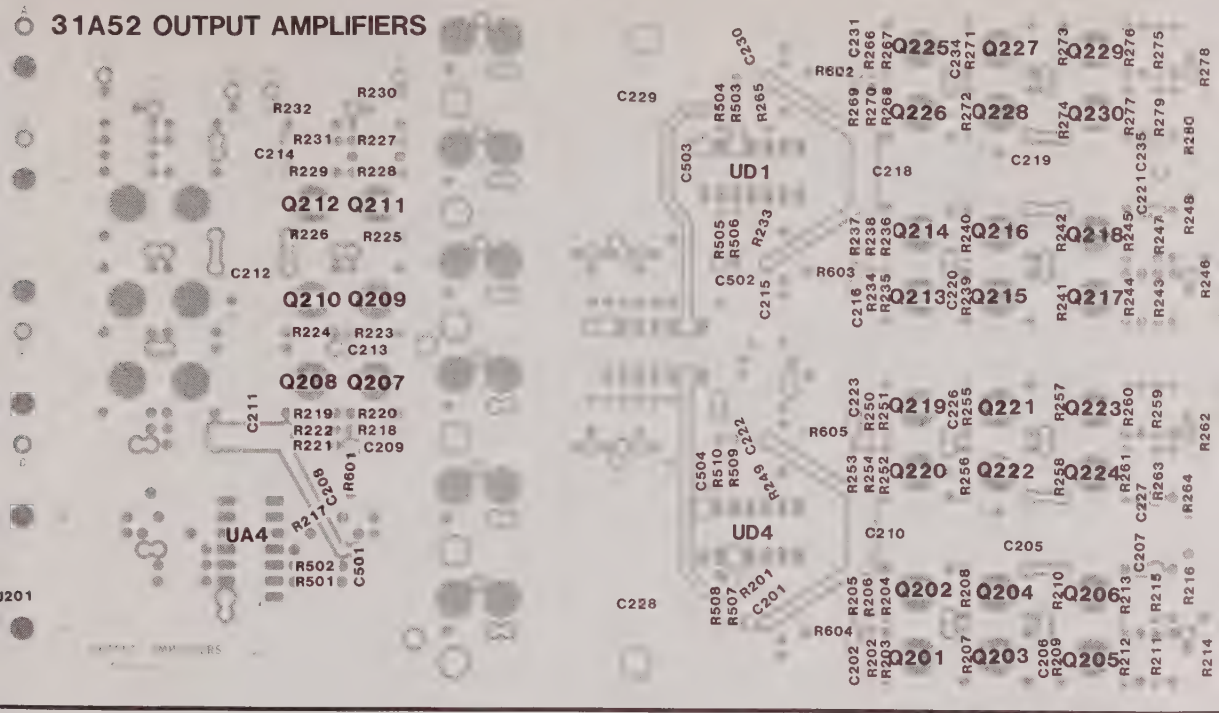

FIRST SET
CK3
CK4
CK5
CK6
R523 470 -5.2V
C119 .01μ
R128 68
R107 390 -5.2V
C109 .01μ
D102 4148
R129 68
R126 390 -5.2V
C110 .01μ
D103 4148
R130 68
R127 390 -5.2V
C111 .01μ
D104 4148
R131 68
R158 390 -5.2
UB3 10131
UC5 10141 2 3 4 5 Q0 Q1 Q2 Q3
UD5 10141 6 7 8 9 Q0 Q1 Q2 Q3
UC4 10141 10 11 12 13 Q0 Q1 Q2 Q3
CP
DL
R535 470 -5.2V
UE4
UE5
UD4
R501 470 -5.2V
R513 470 -5.2V
R550 470 -5.2V
R502 470 -5.2V
R503 470 -5.2V
R544 470 -5.2V
R538? 470 -5.2V
R540 470 -5.2V
R541 470 -5.2V
R542 470 -5.2V
R534 470 -5.2V

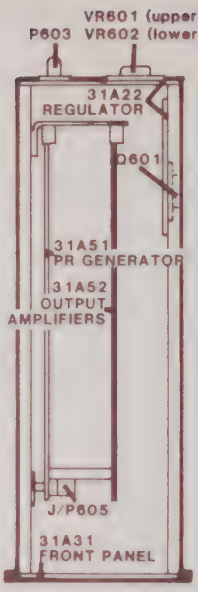

DELTA SET
LAST SET
CK7
CK8'
R145 68
R159 390
C113 .01µ
D106 4148
-5.2V
R154 68
R155 390
C116 .01µ
D105 4148
UC2 10141
18 19 20 21
CP
DL
Q0 Q1 Q2 Q3
UE3 10131
D
Q
CK
Q'
UD3
UD2
UE4
UF4
UF5
UD4
UB4
R524 470
R553 470
R544 470
R559 470
R504 470
R551 470
R546 470
R539 470
R549 470
R548 470
R563 470
R547 470
R556 470
R557 470
R558 470
R560 470
R565 470
R552 470
R555 470
R561 470
R562 470




EEDBACK
GATE
CKB
UD1
FEEDBACK 1
UD1
FEEDBACK 2
31A52 OUTPUT AMPLIFIERS
XA51
XA42
UE2
K
L
DATA
J
R580 470
-5.2V
R579 470
-5.2V
ZERO DET
UE3
R569 470
-5.2V
SYNC DET
UE3
R565 470
-5.2V
CK UE3 10131
R574 470
-5.2V
UE2
H
J
SYNC
C
R578 470
-5.2V
RUN STATUS
C107 47
R123 1k
R125 20
Q107 8771
R573 470
-5.2V
R124 7.5k
-5.2V
J605
P605
9
10
-5.2V
31A31 FRONT PANEL
DS504 5023
RUN
TDJ-53234 REV4
Form 0154-0681C TAU-TRON MN-1
2 of 2 31A51 PR GENERATOR
31-611

31A52 OUTPUT AMPLIFIERS





PARTS VALUES

Unless noted otherwise
C in μF
L in μH
R in Ω
· special, see parts list

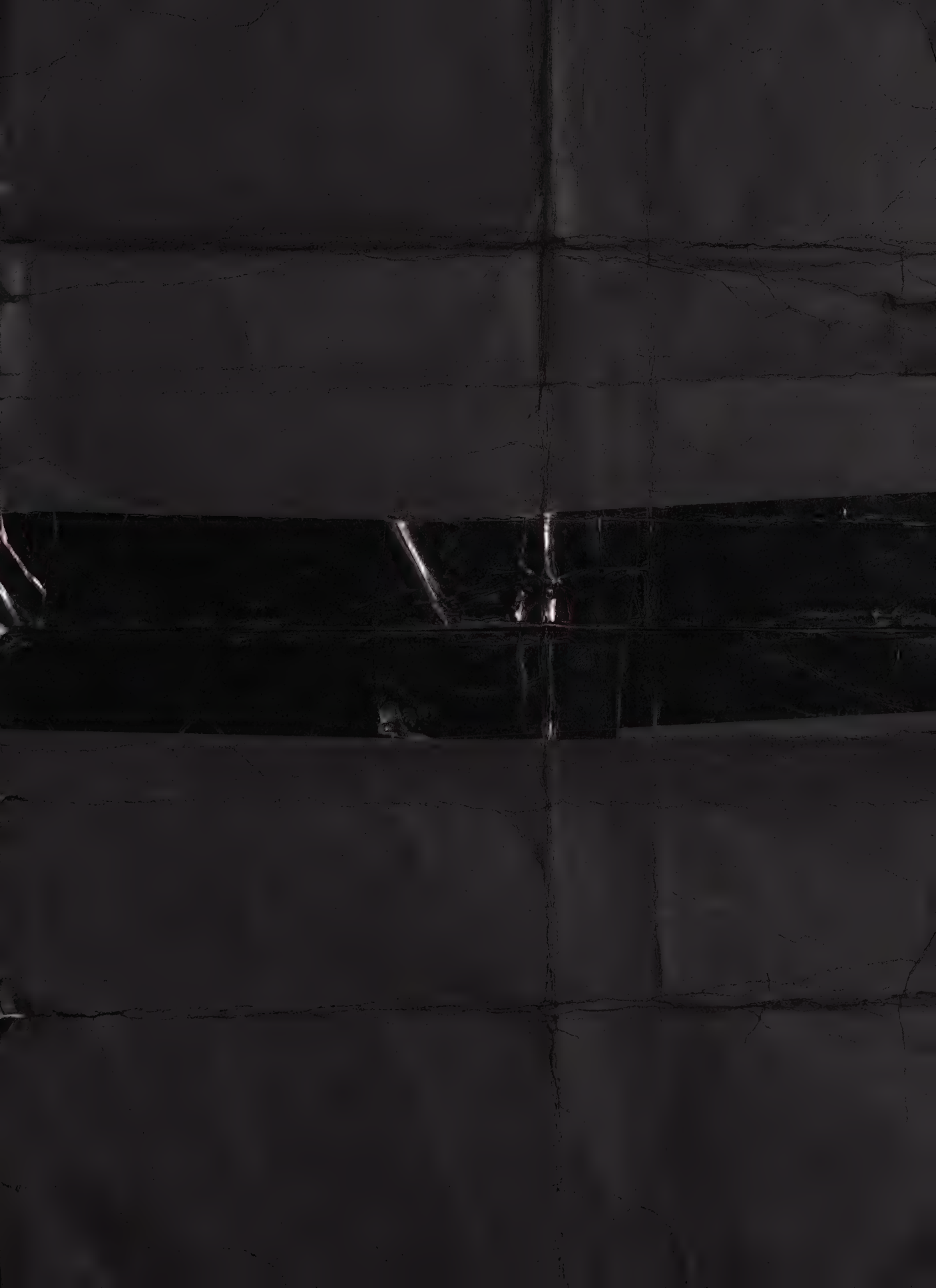
For full type numbers of ICs and transistors, see parts list

REFERENCE DESIGNATIONS

Full reference designations include assembly prefix

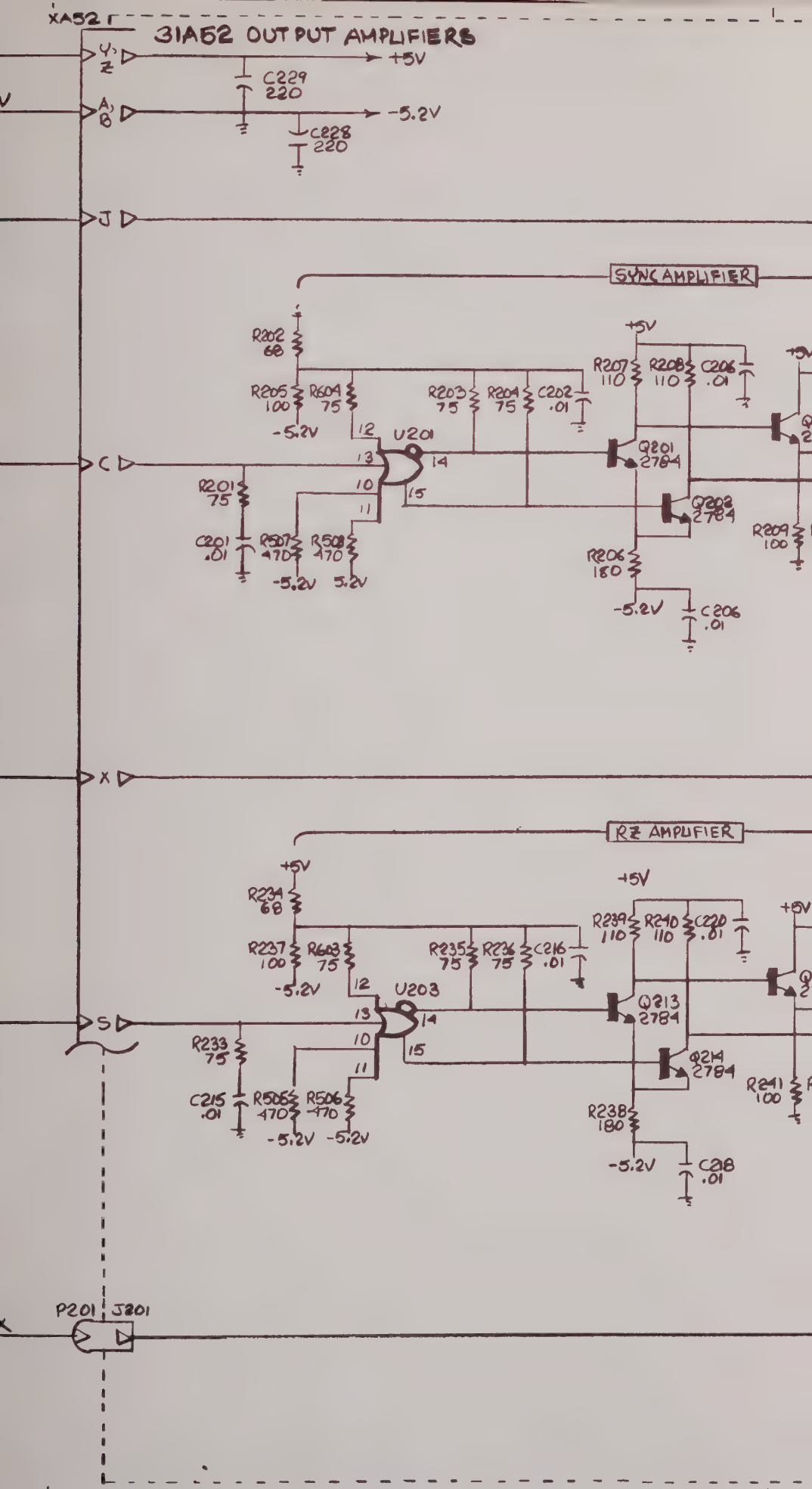
SIGNAL ORIGIN

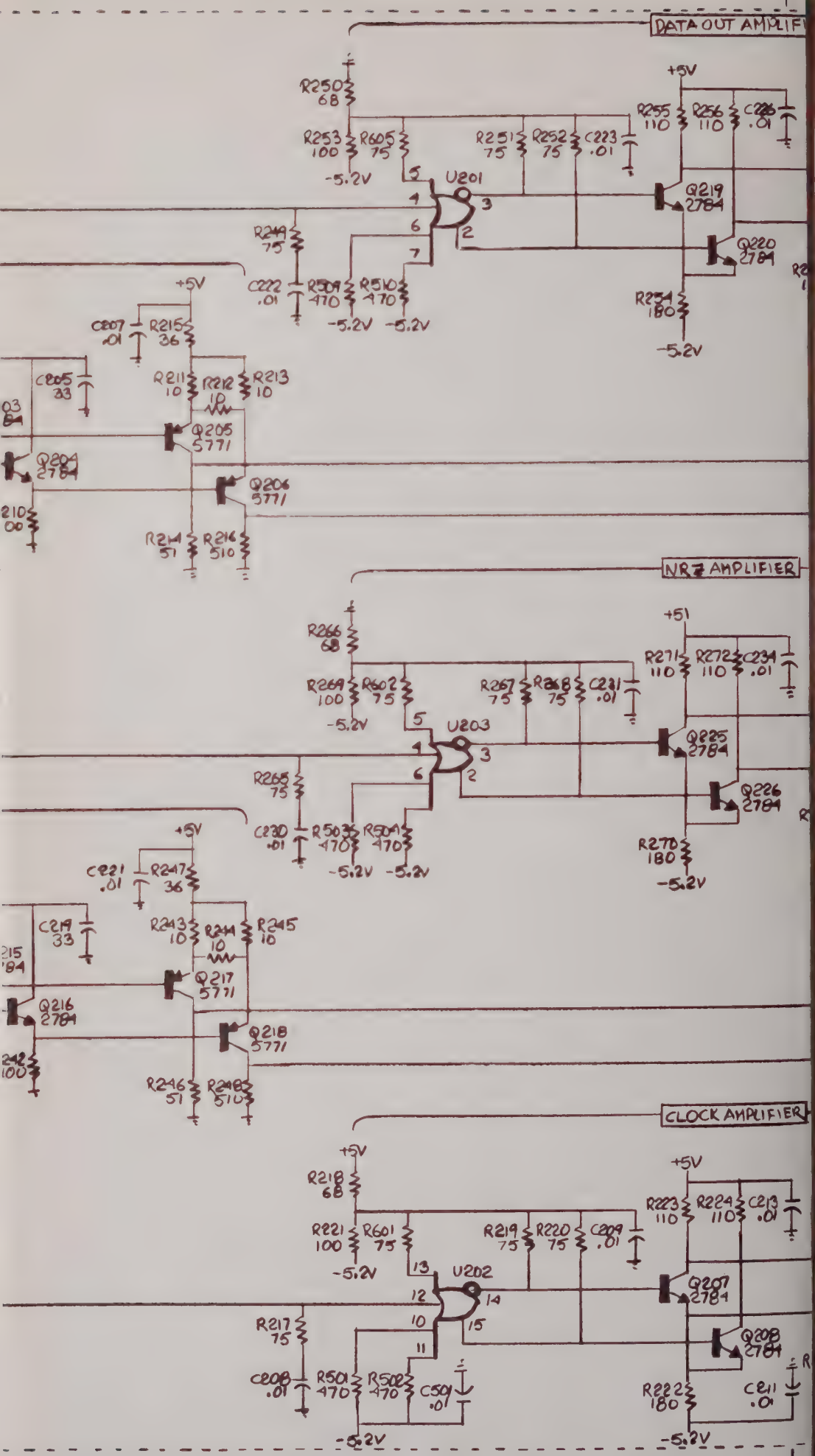
·› input
‹· output

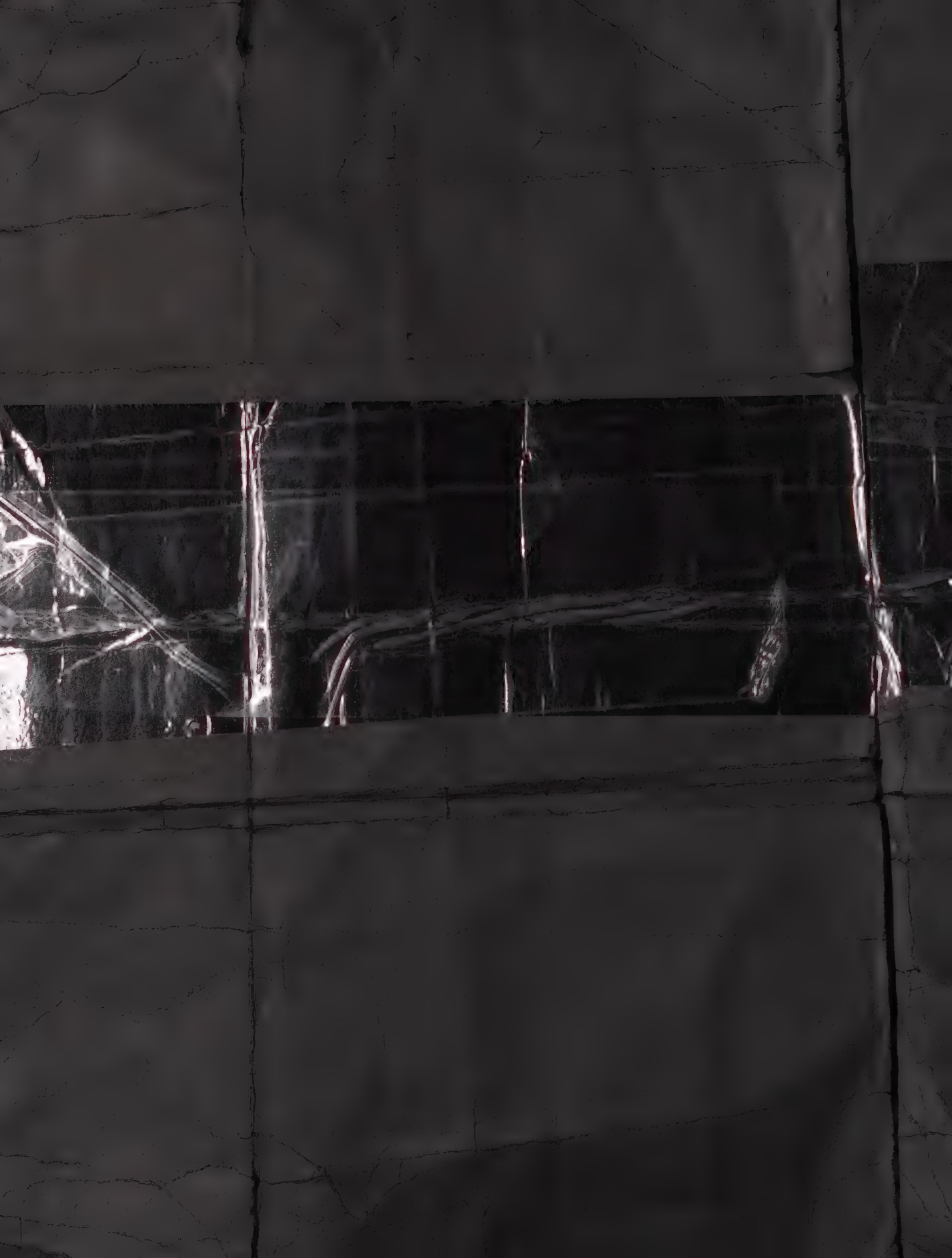


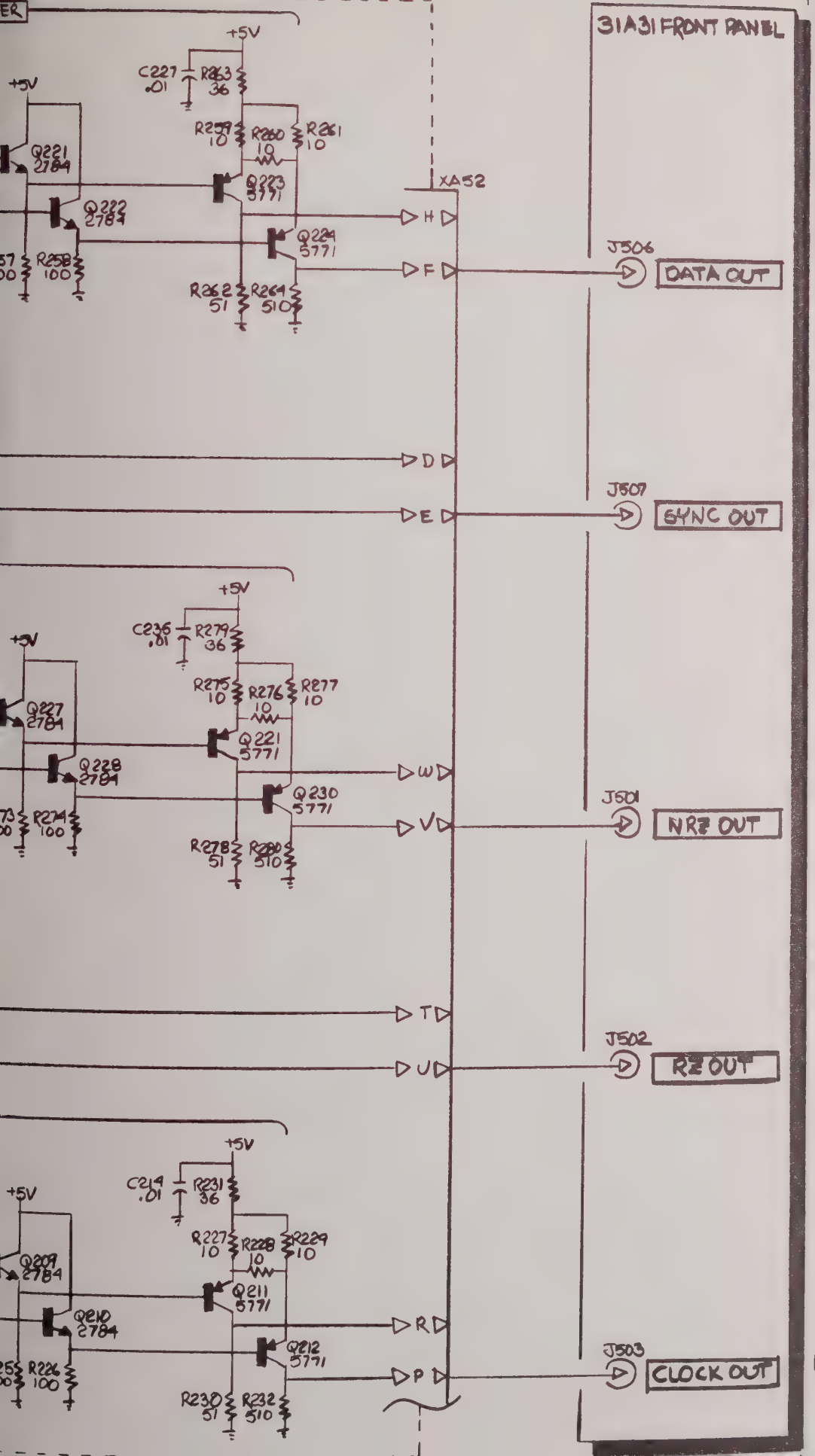
XA52

31A52 OUTPUT AMPLIFIERS




DATA OUT AMPLIFIER
R250 68
R253 100
R605 75
-5.2V
U201
R251 75
R252 75
C223 .01
+5V
R255 110
R256 110
C226 .01
Q219 2784
Q220 2784
R254 180
-5.2V
R249 75
C222 .01
R509 470
R510 470
-5.2V
-5.2V
+5V
C207 .01
R215 36
C205 33
R211 10
R212 10
R213 10
Q205 5771
Q204 2784
Q206 5771
R210 00
R214 51
R216 510
NRZ AMPLIFIER
R266 68
R269 100
R602 75
-5.2V
U203
R267 75
R268 75
C231 .01
+5V
R271 110
R272 110
C234 .01
Q225 2784
Q226 2784
R270 180
-5.2V
R265 75
C230 .01
R503 470
R504 470
-5.2V
-5.2V
+5V
C221 .01
R247 36
C219 33
R243 10
R244 10
R245 10
Q217 5771
Q216 2784
Q218 5771
R242 100
R246 51
R248 510
CLOCK AMPLIFIER
R218 68
R221 100
R601 75
-5.2V
U202
R219 75
R220 75
C209 .01
+5V
R223 110
R224 110
C213 .01
Q207 2784
Q208 2784
R222 180
C211 .01
-5.2V
R217 75
C208 .01
R501 470
R502 470
C501 .01
-5.2V





TDJ-53-201 REV2

Form 0154-068K
TAU-TRON
MN-1

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OUTPUT
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Changes

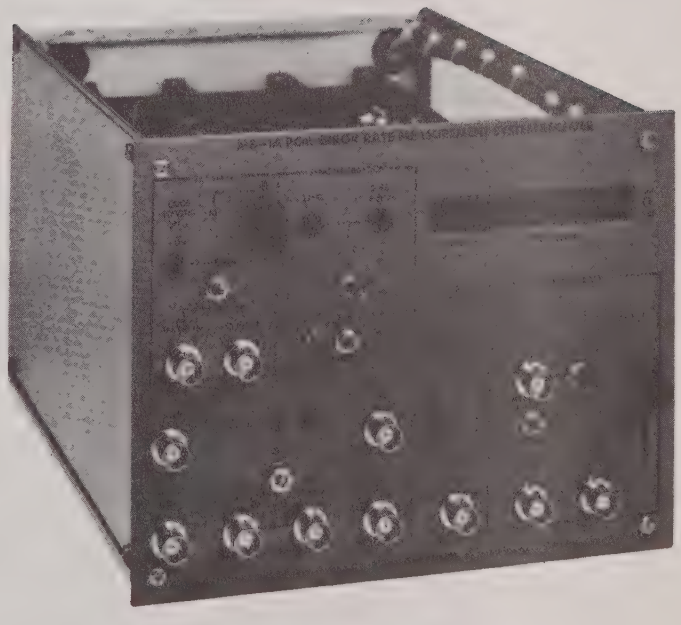
31.700 **CONTENTS**

Where not contained in the body of the manual, information on options, variations, and modifications is contained in this section.

tau-tron
A UNIT OF GENERAL SIGNAL

CONFIGURATION

Your unit is **serial number** _____ and is configured as follows (information on these differences is contained in the body of the manual and/or in the rear of the manual under Changes):



Options:

_____OP-01A ECL into 50Ω to -2V
_____OP-01B ECL into 50Ω to gnd
_____OP-01C ECL into 100Ω to -2V
_____OP-01D ECL into 100Ω to gnd

_____OP-07 Extended Resolution

Variations:

Printer interface differences:
_____Strobe negative true, _____ms
_____Busy, positive true, _____ms

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MB-1A

BERT RECEIVER

INSTRUCTION MANUAL
Form 0155-1081C

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(617) 256-9013 Telex 951952

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61.101 SCOPE

This instruction manual provides operation and maintenence information for the Tau-Tron MB-1A BERT Receiver, including all serial numbers, options, variations, and modifications.

61.102 DESCRIPTION

The Tau-Tron MB-1A BERT Receiver is a half-size Tau-Tron Modular Instrument that provides error detection and measurements of pseudorandom and other patterns.

61.103 SPECIFICATIONS

Clock Input	1 Hz to 75 MHz, 5ns width, 2V into 50Ω to ground, sinewave or square-wave, applied to front-panel BNC connector. Other levels possible, see Option 01. Front-panel LED lights when clock transitions are detected.
Data Input	1 b/s to 75 MB/s, NRZ format, 2V into 50Ω to ground, applied to front-panel BNC connector. Other levels possible, see Option 01. Front-panel LED lights when data transitions are detected. PHASE: Front-panel adjustment delays clock input with respect to data input from 0 to 30 ns for proper clock/data phasing. Max usable range is 50% duty cycle minus 5ns; front-panel LED lights when phase relationship is correct.
Reference Data Input	1 b/s to 75 Mb/s, NRZ format, 2V into 50Ω to ground, applied to front-panel BNC connector, for fixed-word reference. Other levels possible, see Option 01.
Command Input	2V min into 50Ω to ground applied to front-panel BNC connector triggers synchronization. Other levels possible, see Option 01.
Sync-Input	2V into 50Ω to ground, applied to front-panel BNC connector, used for frame measurements with fixed-pattern reference. Other levels, possible, see Option 01. Should occur once per fixed pattern, min width is one clock period.
Gate Input	2V into 50Ω to ground, applied to front-panel BNC connector, inhibits error and timebase generators. Other levels possible, see Option 01.

Clear Input	2V into 50Ω to ground, applied to front-panel BNC connector, resets display, timebase, and error counters. Other levels possible, see Option 01.
Data Patterns	Pseudorandom or fixed word. A front-panel LED lights when a pseudorandom reference pattern is being generated. PSEUDORANDUM: 2^6-1 (63), 2^9-1 (511), 2^{15}-1 (32,767), 2^{17}-1 (131.071), or 2^{20}-1 (1,048,575) bits. FIXED WORD: As determined by external reference data input.
Synchronization	Three modes are available, automatic, manual, and external, as selected by a front-panel switch. Front-panel LED lights when synchronization occurs. AUTOMATIC: Automatically searches for synchronization when error rate exceeds 20 errors in 100 bits or 500 errors in 2500 bits as selected by front-panel switch. MANUAL: Synchronization is triggered by a front-panel pushbutton. EXTERNAL: Synchronization is triggered by an external signal applied to the Command Input.
Measurement	Six modes are available as selected by front-panel controls with 4-digit measurement resolution (6-digit with Option 07) plus overflow; and LED indicates when a measurement is in progress. Front-panel button clears display and resets counter when pushed, allows measurement to proceed when released. TOTAL BIT ERRORS: Bit errors accumulated indefinitely. TOTAL BLOCK ERRORS: Error-blocks accumulated indefinitely, with block lengths of 10,100, or 1000 bits as set by a front-panel control. BIT ERROR RATE: Bit error rate measured, with range selection of 10^{-1} through 10^{-10}. BLOCK ERROR RATE: Errored blocks measured, with range selection of 10^{-1} through 10^{-10}. BIT ERRORS PER FRAME: Bit errors per total frames measured, with range selection of 10^{-1} through 10^{-10}. BLOCK ERRORS PER FRAME: Errored blocks per total frames measured, with range selection of 10^{-1} through 10^{-10}.
Display	4-digit (6 sigit with Option 07) display plus overflow provides measurement data. Front-panel LED lights when error-rate threshold is exceeded.
Auxiliary Outputs	Five auxiliary outputs are provided at 2V into 50Ω to ground via front-panel BNC connectors. Other levels possible, see Option 01. CLOCK: 5ns pulse. SYNC: Once per pseudorandom sequence or following input sync, one clock period wide. OUT OF SYNC: Indicates reference data synchronization has been lost. ERROR: 5ns pulse per bit error detected. TIMEBASE OUT: Selected timebase rate signal.
Power	+17V nominal at 1.9A, -17V nominal at 3.4A, both unregulated and supplied by mainframe.
Cooling	Forced air, supplied by mainframe.
Mechanical	TMI half-size module. DIMENSIONS: 6.375 in high X 8 in wide X 11 in deep. WEIGHT: 5 lb net, 7 lb shipping.

Printer Interface	For use with auxiliary printer such as the Tau-Tron MR-1. Parallel BCD data. Accepts printer busy input and other control signals, TTL compatible. Width of printer strobe and printer hold-off may be specified.
Option 01 Special Levels	Input and output levels other than standard TMI 2V into 50Ω to ground are available. Such levels include TTL with 50Ω to ground and ECL with 50 or 100Ω to ground or to -2V.
Option 07 Extended Resolution	Six-digit display.

61.104 **WARRANTY**

All Tau-Tron products are warranted against any defects in material and workmanship. This warranty applies for one year from the date of delivery for all Tau-Tron manufactured products. The warranty period for OEM products sold by Tau-Tron will depend on the original OEM warranty (consult factory for specific products). We will repair or replace products which, upon our examination, prove to be defective during the warranty period.

NO OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING FITNESS FOR PURPOSE, MERCHANTABILITY OR OTHERWISE, IS GIVEN.

For any assistance, contact Customer Service with details of the instrument model, serial numbers, and malfunction, see Repair Returns below.

61.105 **SHIPPING DAMAGE**

If any signs of damage are noted on the outside of the carton, request the carrier's agent to be present during unpacking. If external damage is found on the instrument follow Repair Returns procedure below.

Check out the electrical performance of the instrument as soon as possible after receipt. If any malfunctions are observed, follow Repair Return procedure below.

61.106 **REPAIR RETURNS**

For mechanical damage or electrical malfunctions, notify Tau-Tron immediately and if the damage occurred during shipping, also notify the carrier. To return a unit for repair:

1. Call the Customer Service Dept., (617)256-9013, for a Repair Authorization Number. This will reduce administrative delays and ensure prompt return of your unit.
2. Complete and attach the Repair Tag, in the rear of the manual, to your unit for positive identification.
3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb) and shock absorbing material such as bubblewrap to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.
4. Send to: Tau-Tron
   27 Industrial Ave.
   Chelmsford, MA 01824
   Attn: Customer Service

61.107 ASSISTANCE

For service assistance call the Tau-Tron Customer Service Dept., (617)256-9013. Their experience and expertise can often save you valuable time in correcting any equipment malfunction.

61.108 POWER

CAUTION Be sure the line switch on the rear panel of the mainframe is set to the proper range (115 or 230V) before connecting to the ac line. If the incorrect range is selected, the instrument could be damaged.

All power for the module is supplied by the mainframe upon insertion of the module.

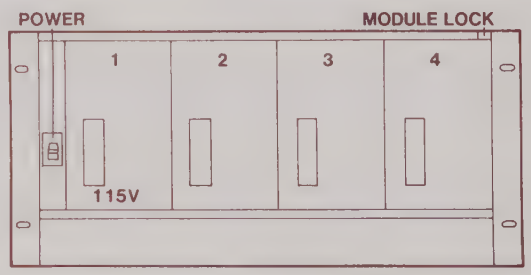
61.109 SITE REQUIREMENTS

Power	All power is supplied by the mainframe which requires 90 to 135V or 180 to 270V, 50 to 60 Hz ac.
Temperature	32 to 113°F (0 to 45°C).
Humidity	0 to 95 % RH, max at 20°C, non-condensing.
Clearances	Cooling is supplied by the mainframe. The only clearances required by the module are those necessary for access to the front-panel operating controls.

61.110 INSTALLATION

Module Insertion

1. Pull out the Module Lock knob.
2. Insert the module as required.
3. Push in the Module Lock knob.



The module(s) can be inserted in any position desired except any user-built module that requires ac power must connect to the position -1 connector. In general, systems shipped by Tau-Tron have modules inserted in the following order:

Position 1...Clock

Position 2...Transmitter

Position 3...Receiver

Module Removal

1. Pull out the Module Lock knob.
2. Grasp the module to be removed by its front-panel BNC connector(s)and pull to remove.
3. Push in the Module Lock knob to prevent the remaining modules from accidently falling out.

Inter-connections

The CLK IN and DATA IN of the MB-1A normally connect to the system under test.

61.111 PRINTER INTERFACE

An external printer, such as a Tau-Tron MR-1 can be connected to a rear-panel connector by means of a 50-pin Amphenol Blue Ribbon series 57-30500 plug. All outputs are TTL compatible and capable of driving up to 3 normal 7400 TTL leads.

Pin	Function	Description
1	Digit 1 BCD 1 (LSB)	All display digits are positive true with a high-level logic -1.
2	Digit 1 BCD 2	
3	Digit 1 BCD 4	
4	Digit 1 BCD 8	* Digits marked with an asterisk are available only on units with Option 07 Extended Resolution.
5	Digit 2 BCD 1	
6	Digit 2 BCD 2	
7	Digit 2 BCD 4	
8	Digit 2 BCD 8	
9	Digit 3 BCD 1	
10	Digit 3 BCD 2	
11	Digit 3 BCD 4	
12	Digit 3 BCD 8	
13	Digit 4 BCD 1	
14	Digit 4 BCD 2	
15	Digit 4 BCD 4	
16	Digit 4 BCD 8 (MSB)	
17	Digit 5* BCD 1	
18	Digit 5* BCD 2	
19	Digit 5* BCD 4	
20	Digit 5* BCD 8	
21	Digit 6* BCD 1	
22	Digit 6* BCD 2	
23	Digit 6* BCD 4	
24	Digit 6* BCD 8 (MSB*)	
25	Overflow	
26	Clear	Input, accepts negative true TTL input which resets display and counter to zero. Loading is one 7400 TTL load plus 1kΩ pullup to +5V, min width is 50 ns.
27	Enable	Input; accepts negative true TTL input which freezes display to allow for synchronization of the display readout, if necessary, with an external controller such as a computer. Loading is one 7400 TTL pullup to +5V.
28	Strobe	Output, normally shipped positive true with 10ms pulse duration, can be restrapped for negative true and revalued (R49 and C1 on 61A54 Interface Board) for different duration. Causes printer to print the display digits and advance one line.

*Digit 4 is most significant digit for normal resolution, Digit 6 is most significant digit for Option 07 Extended Resolution. Digits 5 and 6 not included unless Option 07 is installed.

29	Busy	Input, normally shipped negative true with display hold time of 100ms, can be restrapped for negative true and revalued (R60 and C2 on 61A54 Interface Board) for different hold time. Causes contents of display to freeze and inhibits further strobes until printer is ready for next print cycle. After the trailing edge of the busy input, the display will remain frozen (hold) and the print strobe inhibited for a time determined by R60 and C2.
30	Interrogate	Input, negative true, Where no internal print strobe occurs such as in the TOTALIZE mode, or for asynchronous print strobes, this input initiates a print-strobe/display-freeze cycle at the negative transition of its input level. Loading is one 7400 TTL load plus 1kΩ pullup to +5V, min width is 50ns.
31	Printer Off	Input, positive true TTL input. Printer control logic is enabled only when this input is low. May be grounded when a printer is connected and left open when printer is not connected. Loading is one 7402 load plus 1kΩ pullup to +5V.
32 thru 42	No connection	
43 thru 50	Ground	

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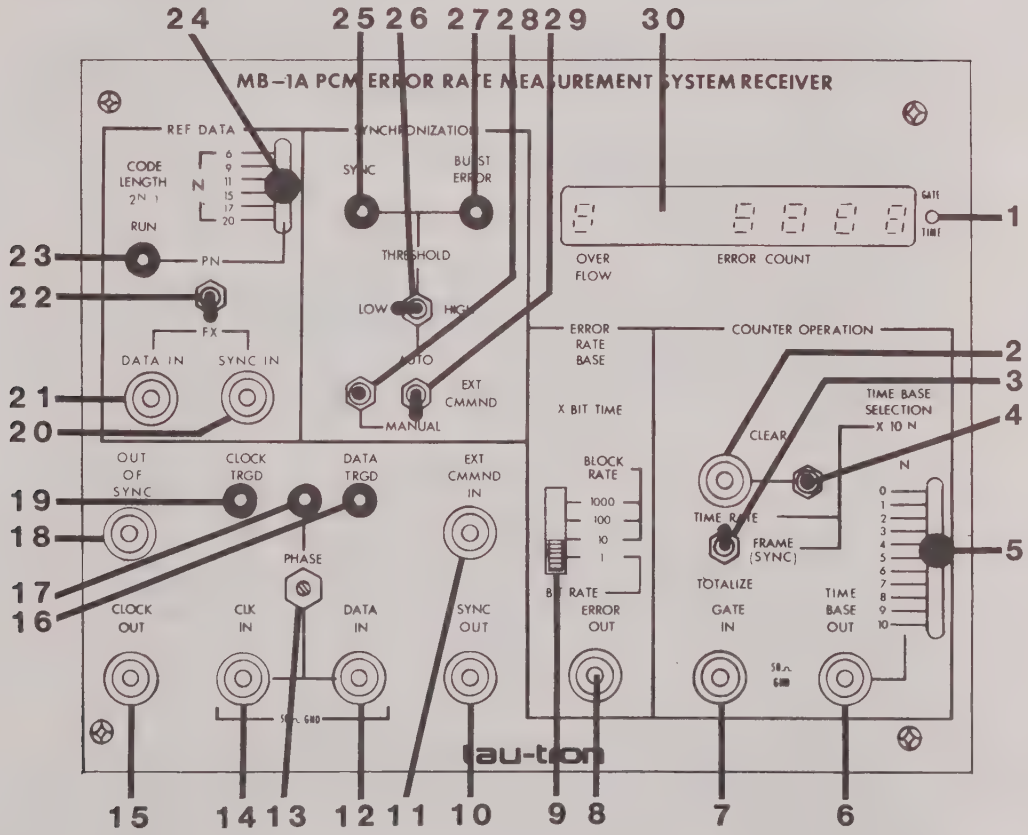
61.201 **FRONT PANEL**



1 GATE TIME — Light-emitting diode lights when a measurement is in progress.

2 CLEAR — BNC input connector for signal at a standard TMI level of 2± 0.3V connector into 50Ω to ground clears the display and resets the counters.

3 Measurement Mode — Three-position toggle switch selects measurement mode:

TOTALIZE.....Bit errors or block errors, as set by the BLOCK RATE control, are accumulated and displayed indefinitely.

FRAME.....Bit errors or block errors, as set by the BLOCK RATE control, per total frames are measured and displayed. The total frames can be from 10^0 to 10^{10} as set by the Timebase control.

TIME RATE....Bit errors or block errors, as set by the BLOCK RATE control, per total bits are measured and displayed. The total bits or blocks can be from 10^1 to 10^{10} as set by the Timebase control.

4 CLEAR button — Momentary pushbutton clears the display and resets the counters when pushed, allows measurement to proceed when released.

5 TIMEBASE — Eleven-position lever switch selects total bits (or blocks) or total frames, as set by the Measurement Mode control, over which error rate is measured. Range is 10^0 (1) through 10^{10} (10,000,000,000).

6 TIME BASE OUT — BNC output connector for output signal at a standard TMI level of 2V ± 0.3V into 50Ω to ground of timebase of 10^0 through 10^{10} as selected by the Time Base control.

7 GATE IN — BNC input connector for signal at a standard TMI level of 2V ± 0.3V into 50Ω to ground to inhibit measurement.

8 ERROR OUT — BNC output connector for 5 ns pulse at a standard TMI level of 2V± 0.3V into 50Ω to ground that occurs each time an error is detected.

9 BLOCK RATE — Four-position slide switch determines whether bit errors (when set to 1) or block errors are to be measured. Blocks can be set for 10,100, or 1000 bits.

10 SYNC OUT — BNC output connector for signal at a standard TMI level of 2V ± 0.3V into 50Ω to ground, one clock period wide, that occurs once per pseudorandom sequence or following input sync.

11 EXT CMMND IN — BNC input connector for signal at a standard TMI level of 2V ± 0.3V into 50Ω to ground that triggers synchronization when Sync Mode is set to EXT CMMND.

12 DATA IN — BNC input connector for signal at a standard TMI level of 2V ± 0.3V into 50Ω to ground.

13 PHASE — Screwdriver adjustment that delays the clock input with respect to the data input from 0 to 30 ns for proper clock/data phasing. Maximum usable range is 50% duty cycle minus 5 ns. Fully ccw is minimum delay.

14 CLK. IN — BNC input connector for clock signal at a standard TMI level of 2V ± 0.3V into 50Ω to ground.

The clock input is normall connected to the clock output from the system under test.

15 CLOCK OUT — BNC output connector for 5 ns clock output pulse at a standard TMI level of 2V± 0.3V into 50Ω to ground. It is a fixed-width pulse at the input clock frequency and can be used as a monitor output for use by an oscilloscope or an electronic counter.

16 DATA TRGD — Light-emitting diode lights when input data transitions are detected.

17 PHASE — Light-emitting diode lights when phase relationship between CLK IN and DATA IN is correct.

18 OUT OF SYNC — BNC output connector for a signal at a standard TMI level of 2V ± 0.3V into 50Ω to ground that indicates an out-of-sync condition.

19 CLOCK TRGD — Light-emitting diode lights when input clock transitions are detected.

20 SYNC IN — BNC input connector for signal at a standard TMI level of 2± 0.3V into 50Ω to ground.

The sync input is used for frame measurements with fixed-pattern reference and should occur once per fixed pattern, with a minimum width of one clock period.

21 DATA IN — BNC input connector for NRZ format data at a standard TMI level of 2± 0.3V into 50Ω to ground; 75 Mb/s max, 5ns min pulse width.

This data input is used as the reference input for externally generated fixed words.

22 PN-FX — Two-position toggle switch determines whether measurements are to be made using pseudorandom sequences or fixed patterns.

This control is normally set to PN (pseudorandom sequences). Measurements on fixed patterns (FX) can be made using external reference DATA IN and SYNC IN.

23 RUN — Light-emitting diode lights when the pseudorandom generator is operating.

24 CODE LENGTH — Six-position lever switch controls the length of the pseudorandom word as 2^6 -1 (63), 2^9 -1 (511), 2^{11} -1 (2047), 2^{15} -1 (32,767), 2^{17} -1 (131,071), or 2^{20} -1 (1,048,576) bits.

25 SYNC — Light-emitting diode indicates a synchronized condition.

26 THRESHOLD — Two-position toggle switch sets threshold above which resynchronization is attempted in AUTO sync mode. LOW threshold is 20 errors in 100 bits, HIGH threshold is 500 errors in 2500 bits.

27 BURST ERROR — Light-emitting diode lights when error threshold is exceeded.

28 SYNC — Momentary pushbutton initiates sync in MANUAL sync mode.

29 SYNC MODE — Three position toggle switch sets sync mode:

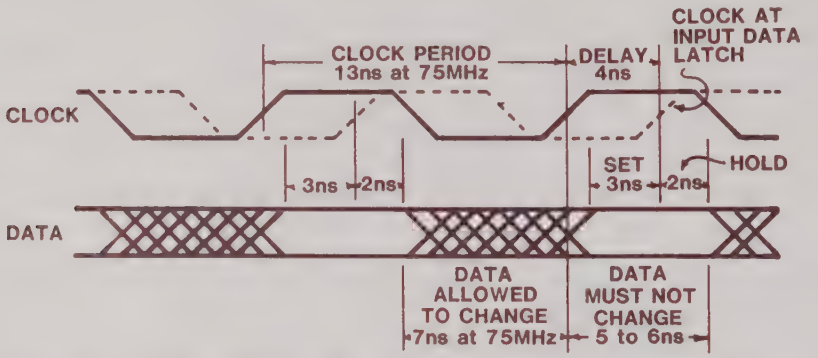
AUTO.....Synchronization is automatically attempted when errors exceed values set by THRESHOLD control.
MANUAL.....Synchronization is attempted when Sync button is pushed.
EXT CMMND....Synchronization is attempted when an external signal is received at the EXT CMMND IN connector.

30 ERROR OUT — Four-digit (six with Option 07) display*plus overflow provides measurement values.

61.202 **PHASING**

Background

Whenever data is applied to the DATA IN connector, the input data must be properly phased with the clock signal applied to the CLOCK IN connector.



Basically this means the data must not change during the 3ns set time and 2ns hold time of the input data latch. Since the internal path of the clock signal to the latch is typically 4ns longer than that of the data path, this translates to a region of some 5 to 6 ns after the rising edge of the clock signal, referred to the input connectors, during which the input data must not change. This relationship becomes critical only at the higher frequencies.

DATA CHANGES ALLOWED			DATA CHANGES ALLOWED		
Frequency	Duration	Percent*	Frequency	Duration	Percent*
75 MHz	7ns	54%	7.5 MHz	124ns	95%
50 MHz	14ns	70%	5 MHz	194ns	97%
25 MHz	34ns	85%	2.5 MHz	394ns	99%
10 MHz	94ns	94%	1 MHz	994ns	>99%

* Percent of total clock period data is allowed to change.

Phase Adjustment

The front-panel screwdriver-PHASE adjustment delays the clock input with respect to the data input from 0 to 30 ns for proper clock/data phasing. Fully ccw is minimum delay.

NOTE

The PHASE adjustment must not be set greater than 50% duty cycle minus 5ns or the measurements will be in error due to the clock input which will be divided by 2 internally.

This is only critical at input clock frequencies of about 14MHz and greater:

	Phase Adjustment	
Frequency	Time	Approximate Position
75MHz	1ns	Slightly cw
65MHz	2ns	
55MHz	4ns	
45MHz	6ns	
35MHz	9ns	
25MHz	15ns	Mid point
15MHz	28ns	
14 MHz	30ns	Fully cw

Proper Phasing — Excess phase adjustment cannot be detected by observing the front-panel PHASE LED at frequencies in excess of about 14 MHz. The best method is to observe the signal at the CLOCK OUT connector to make sure it is at the same frequency as the clock input.

61.203 INTERNAL REFERENCE

For normal testing using the internal reference generator, the PN reference mode is selected.

In this mode the only inputs required are the clock and data inputs from the system under test. The internal synchronization circuits are operable so the full choice of synchronization methods is available. In the PN mode, the following connections and settings are used:

PN-FX — PN. An illuminated RUN indicator denotes proper operation of the internal reference generator.

CLK IN — Connect to clock output of the system under test. Proper clock input is indicated by an illuminated CLOCK TRIGD indicator.

DATA IN — Connect to data output of the system under test. Proper data input is indicated by an illuminated DATA TRIGD indicator.

PHASE — Set the PHASE screwdriver adjust, if necessary, for proper phasing as indicated by an illuminated PHASE indicator (see paragraph 61.202).

NOTE — The PHASE adjustment must not be set greater than 50% duty cycle minus 5ns or the measurement will be in error (see paragraph 61.202).

CODE LENGTH — Same as data generator.

Sync Mode — As desired:

AUTO.....This is the normal mode. Synchronization is attempted automatically when errors exceed the values set by the THRESHOLD control, below.

MANUAL.....Synchronization is attempted when the Sync button is pushed.

EXT CMMND.....Synchronization is attempted when an external signal is received at the EXT CMMND IN connector.

Proper synchronization is indicated by an illuminated SYNC indicator. The BURST ERROR indicator is illuminated when the receiver is out-of-sync.

THRESHOLD — Sets out-of-sync level and in the AUTO sync mode and sets the error threshold above which automatic synchronization is attempted:

LOW.....20 errors in 100 bits. This setting detects an out-of-sync condition faster but is suceptible to error bursts (short periods of high error rate).

HIGH.....500 errors in 2500 bits.

EXT CMMND IN	Used only with EXT CMMND Sync Mode.
ERROR OUT	No connection required. Useful for automatic logging of error activity such as with a Tau-Tron S5000 Printing Error Analyzer.
OUT OF SYNC	No connection required. Useful for automatic logging as an indication of data confidence.
CLOCK OUT	No connection required. Useful as a monitor output for use by an oscilloscope or an electronic counter.
SYNC OUT	No connection required. Useful as a trigger signal for an oscilloscope monitor.
GATE IN	No connection required. Used only for external control of measurement start and stop.
TIME BASE OUT	No connection required.
REF DATA IN	No connection required. Used only for external reference.
SYNC IN	No connection required. Used only with external reference.

For other control settings, see paragraphs 61.205 thru 61.210.

61.204 EXTERNAL REFERENCE

For fixed-word data patterns, or any desired pattern from an external source, the FX reference mode is selected.

In this mode, the reference data must be supplied externally and be properly aligned to the DATA IN from the system under test. The internal synchronization circuits are described in this mode and function only as a synchronization detector. In the FX mode the following connections and settings are used:

PN-FX	FX
CLK IN	Connect to clock output of the system under test. Proper clock input is indicated by an illuminated CLOCK TRIGD indicator.
DATA IN	Connect to data output of the system under test. Proper data input is indicated by an illuminated DATA TRIGD indicator.
PHASE	Set the PHASE screwdriver adjust, if necessary, for proper phasing as indicated by an illuminated PHASE indicator (see paragraph 61.202).
NOTE	The PHASE adjustment must not be set greater than 50% duty cycle minus 5ns or the measurement will be in error (see paragraph 61.202).
REF DATA IN	Connect to the external reference data. This data must be aligned bit-by-bit with the data in from the system under test.
CODE LENGTH	Same as data generator.
SYNC IN	No connection required. Used only when a SYNC OUT signal is required or when FRAME measurements are made.
SYNC OUT	No connection required. Useful as a trigger signal for an oscilloscope monitor.

ERROR OUT	No connection required. Useful for automatic logging of error activity such as with a Tau-Tron S5000 Printing Error Analyzer.
OUT OF SYNC	No connection required. Useful for automatic logging as an indication of data confidence.
CLOCK OUT	No connection required. Useful as a monitor output for use by an oscilloscope or an electronic counter.
GATE IN	No connection required. Used only for external control of measurement start and stop.
TIME BASE OUT	No connection required.
SYNC MODE	No effect.
THRESHOLD	Sets out-of-sync indication level.
EXT CMMND IN	No effect.

For other control settings, see paragraphs 61.205 thru 61.210.

61.205 **TOTAL BIT ERRORS**

For internal reference, see paragraph 61.203.
For external reference, see paragraph 61.204.

Measurement Mode	TOTALIZE
BLOCK RATE	1

Push the CLEAR button to initialize the measurement. The display will indicate the errors counted up to 4 digits (6 with Option 07) plus overflow (9999 or 999,999).

61.206 **TOTAL BLOCK ERRORS**

For internal reference, see paragraph 61.203.
For external reference, see paragraph 61.204.

Measurement Mode	TOTALIZE
BLOCK RATE	10,100, or 1000 bits, as required for desired block length.

Push the CLEAR button to initialize the measurement. The display will indicate the number of blocks in which a bit error occurred up to 4 digits (6 with Option 07) plus overflow (9999 or 999,999).

61.207 **BIT ERROR RATE**

For internal reference, see paragraph 61.203.
For external reference, see paragraph 61.204.

Measurement Mode TIME RATE

BLOCK RATE 1

Measurements are made automatically or can be initialized by pushing the CLEAR button. The display will indicate the bit error rate (bit errors divided by the total number of bits counted as set by the TIMEBASE control) up to 4 digits (6 with Option 07) plus overflow (9999 or 999,999) X 10^{0} through 10^{-10}.

The display is not blanked during a measurement so that the accumulating count is visible. After the measurement is complete, the display holds the results for a period of from about 1 second (minimum and normal) to several thousand years depending on the clock rate and timebase selected. The measurement can be cleared and a new measurement started at any time by pushing the CLEAR button.

For maximum resolution, the TIME BASE normally should be set for the maximum displayed count without overflow. For example, if the count is 838 X 10^{-4} (838 bit errors out of 10,000 total bits), increasing the TIMEBASE to 5 may result in a count of, say, 8383 X 10^{-5}.

Two difficulties may arise. First, increasing the number of total bits may result in an overflow in which case the lower setting must be used. Second, increasing the total bits can result in very long measurement times at the low clock rates. For example to measure 10^{9} bits (1,000,000,000) at a 1kHz clock rate would take 11 days.

61.208 **BLOCK ERROR RATE**

For internal reference, see paragraph 61.203.
For external reference, see paragraph 61.204.

Measurement Mode TIME RATE

BLOCK RATE 10, 100 or 1000 bits, as required for desired block length.

Measurements are made automatically or can be initialized by pushing the CLEAR button. The display will indicate the block error rate (blocks in which an error occurred divided by the total number of blocks counted as set by the TIMEBASE control) up to 4 digits (6 with Option 07) plus overflow (9999 or 999,999) X 10^{-1} through 10^{-10}.

The display is not blanked during a measurement so that the accumulating count is visible. After the measurement is complete, the display holds the results for a period of from about 1 second (minimum and normal) to several thousand years depending on the clock rate, block length, and time base selected. The measurement can be cleared and a new measurement started at any time by pushing the CLEAR button.

For maximum resolution, the TIMEBASE normally should be set for the maximum displayed count without overflow. For example, if the count is 838 X 10^{-4} (838 errored blocks out of 10,000 total blocks), increasing the TIMEBASE to 5 may result in a count of, say, 8383 X 10-5.

Two difficulties may arise. First, increasing the number of total blocks may result in an overflow in which case the lower setting must be used. Second, increasing the total blocks can result in very long measurement times at low clock rates. For example to measure 10^6 blocks (1,000,000) of 1000 bits at a 1kHz clock rate would take 11 days.

61.209 **BIT ERRORS PER FRAME**

For internal reference, see paragraph 61.203.
For external reference, see paragraph 61.204.

Measurement Mode TIME RATE

BLOCK RATE 1

Measurements are made automatically or can be initialized by pushing the CLEAR button. The display will indicate the bit errors per frame (bit errors divided by the total number of frames counted as set by the TIMEBASE control) up to 4 digits (6 with Option 07) plus overflow (9999 or 999,999) X 10^{-1} through 10^{-10}.

The display is not blanked during a measurement so that the accumulating count is visible. After the measurement is complete, the display holds the results for a period of from about 1 second (minimum and normal) to several thousand years depending on the clock rate, the frame length, and time base selected. The measurement can be cleared and a new measurement started at any time by pushing the CLEAR button.

For maximum resolution, the TIMEBASE normally should be set for the maximum displayed count without overflow. For example, if the count is 838 X 10^{-4} (838 bit errors out of 10,000 total frames), increasing the TIMEBASE to 5 may result in a count of, say, 8383 X 10^{-5}.

Two difficulties may arise. First, increasing the number of total blocks may result in an overflow in which case the lower setting must be used. Second, increasing the total blocks can result in very long measurement times at low clock rates. For example to measure 10^6 frames of 2^9-1 bits each at a 1kHz clock rate would take 6 days.

61.210 **BLOCK ERRORS PER FRAME**

For internal reference, see paragraph 61.203
For external reference, see paragraph 61.204.

Measurement Mode	TIME RATE
BLOCK RATE	10, 100 or 1000 bits, as required for desired block length.

Measurements are made automatically or can be initialized by pushing the CLEAR button. The display will indicate the block errors per frame (blocks in which an error occurred divided by the total number of frames counted as set by the TIMEBASE control) up to 4 digits (6 with Option 07) plus overflow (9999 or 999,999) X 10^{-1} through 10^{-10}.

The display is not blanked during a measurement so that the accumulating count is visible. After the measurement is complete, the display holds the results for a period of from about 1 second (minimum and normal) to several thousand years depending on the clock rate, the frame length, and timebase selected. The measurement can be cleared and a new measurement started at any time by pushing the CLEAR button.

For maximum resolution, the TIME BASE normally should be set for the maximum displayed count without overflow. For example, if the count is 838 X 10^{-4} (838 errored blocks out of 10,000 total blocks), increasing the TIMEBASE to 5 may result in a count of, say, 8383 X 10^{-5}.

Two difficulties may arise. First, measuring the number of total blocks may result in an overflow in which case the lower setting must be used. Second, increasing the total blocks can result in very long measurement times at low clock rates. For example, to measure 10^6 frames of 2^9-1 bits each at a 1kHz clock rate it would take 6 days.

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61.301 BASIC PRINCIPLES

Powers of Two

Characterization of pseudorandom generators and much of the operation of the related circuitry is based on powers of two.

2^n	
n	DECIMAL
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
9	512
10	1,024
11	2,048
12	4,096

2^n	
n	DECIMAL
13	8,192
14	16,384
15	32,768
16	65,536
17	131,072
18	262,144
19	524,288
20	1,048,576
21	2,097,152
22	4,194,304
23	8,388,608
24	16,777,216

2^n	
n	DECIMAL
25	33,554,432
26	67,108,864
27	134,217,728
28	268,435,456
29	536,870,912
30	1,073,741,824
31	2,147,483,648
32	4,294,967,296
33	8,589,934,592
34	17,179,869,184
35	34,359,738,368
36	68,719,476,736

Shift Register

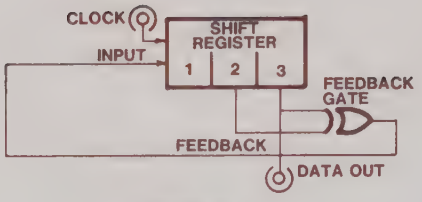
A shift register is a series of cascaded flip-flop stages. Upon application of a clock pulse, an input value is accepted into the first stage. With each succeeding clock pulse, the input value is shifted to the next stage. With no new input value, the clock pulses will eventually clear the register.

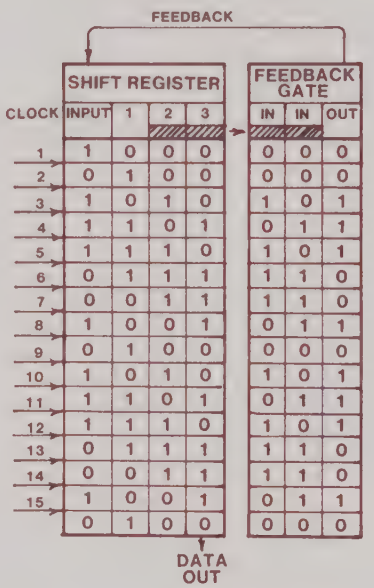
	SHIFT REGISTER			
CLOCK	INPUT	1	2	3
	0	0	0	0
1 →	1	0	0	0
2 →	0	1	0	0
3 →	0	0	1	0
4 →	0	0	0	1
5 →	0	0	0	0

Generation

In a pseudorandom generator, a feedback path containing a modulo -2 adder (2-input exclusive-or gate) is added to the shift register. The inputs to the gate are taken from two stages of the shift register, and the output is fed back to the input of the register.

The resultant data out is a binary sequence of ones and zeros that fulfills the conditions of randomness, yet is a repeating pattern.





CLOCK	INPUT	1	2	3	IN	IN	OUT
1	1	0	0	0	0	0	0
2	0	1	0	0	0	0	0
3	1	0	1	0	1	0	1
4	1	1	0	1	0	1	1
5	1	1	1	0	1	0	1
6	0	1	1	1	1	1	0
7	0	0	1	1	1	1	0
8	1	0	0	1	0	1	1
9	0	1	0	0	0	0	0
10	1	0	1	0	1	0	1
11	1	1	0	1	0	1	1
12	1	1	1	0	1	0	1
13	0	1	1	1	1	1	0
14	0	0	1	1	1	1	0
15	1	0	0	1	0	1	1
	0	1	0	0	0	0	0

Sequence Length

The number of bits in the pattern (sequence length) is determined by the number of states in the shift register and the feedback taps used.

Maximum Length = 2^n-1

Where n is the number of stages and the -1 is due to the exclusion of the all-zeros state of the shift register (an all-zeros condition would feedback a zero and result in a useless, continuing sequence of all zeros).

A reversed bit pattern can be obtained by altering the feedback taps.

STAGES	FORWARD TAPS	REVERSE TAPS	SEQUENCE LENGTH (BITS)
3	2,3	1,3	7
4	3,4	1,4	15
5	3,5	2,5	31
6	5,6	1,6	63
7	6,7	1,7	127
8	1,6,7,8	1,2,7,8	255
9	5,9	4,9	511
10	7,10	3,10	1,023
11	9,11	2,11	2,047
12	2,10,11,12	1,2,10,12	4,095
13	1,11,12,13	1,2,12,13	8,191
14	2,12,13,14	1,2,12,14	16,383
15	14,15	1,15	32,767
16	11,13,14,16	2,3,5,16	65,535
17	14,17	13,17	131,071
18	11,18	7,18	262,143
19	14,17,18,19	1,2,5,19	524,287
20	17,20	3,20	1,048,575
21	19,21	2,21	2,097,151
22	21,22	1,22	4,194,303
23	18,23	5,23	8,388,607
25	22,25	3,25	33,554,431
28	25,28	3,28	268,435,455
29	27,29	2,29	536,870,911
31	28,31	3,31	2,147,483,647
33	20,33	13,33	8,589,934,591
35	33,35	2,35	34,359,738,367
36	25,36	11,36	68,719,476,735

Run Length Distribution

Runs of consecutive ones (bounded by zeros) and consecutive zeros (bounded by ones) are given by:

$$\text{Runs} = 2^{n-(p+2)}$$

where p = the run length, and where the expression is valid for all run lengths except n (there is only one run of length n and it is all ones) and n-1 (there is only one run of length n-1 and it is all zeros).

GENERATOR	RUN LENGTH	ONES	ZEROS
3-STAGE	3	1	0
	2	0	1
	1	1	1
15-STAGE	15	1	0
	14	0	1
	13	1	1
	12	2	2
	11	4	4
	10	8	8
	9	16	16
	8	32	32
	7	64	64
	6	128	128
	5	256	256
	4	512	512
	3	1,024	1,024
	2	2,048	2,048
	1	4,096	4,096

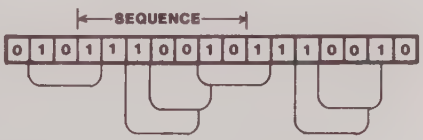
Ones and Zeros Distribution

The number of ones in a pseudorandom sequence is always one more than the number of zeros. For generators larger than 6 or 7 stages, this means the number of ones and zeros is essentially equal. With no signal applied (i.e., a "signal" of all zeros), the error count will be within ±1 count of 50% (50×10^{-2} or 50E2 in engineering notation).

STAGES	ERROR RATE WITH NO SIGNAL
3	57 ± 1 E2
4	53 ± 1 E2
5	51 ± 1 E2
6	50 ± 1 E2
7	50 ± 1 E2

Sync

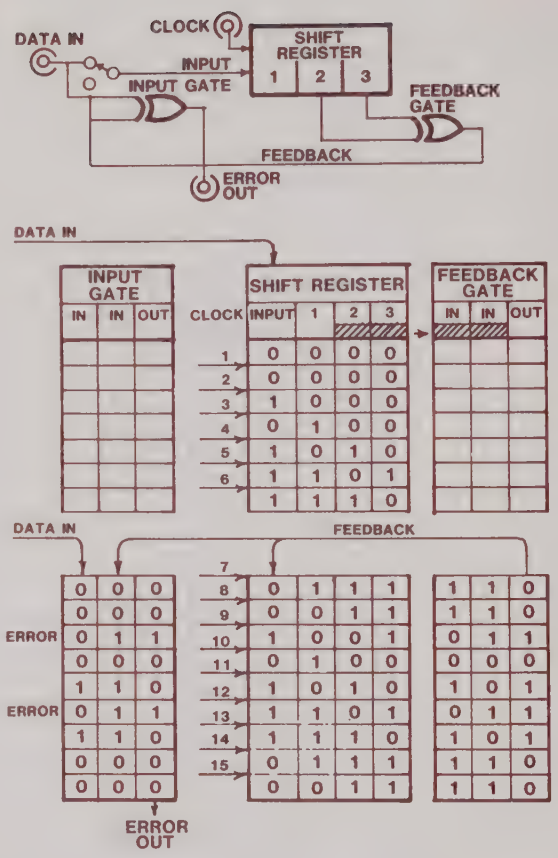
Each group of n bits within a sequence is unique and does not appear more than once. For example, for a 3-stage generator a sequence of 101 appears only once, as does 001 or 100, etc. This property makes synchronization of two identical generators possible.



Error Detection

For error detection, the input to the shift register first comes directly from the Data In. The inputs to the feedback gate are set so that they are from the same taps of the shift register as those used by the shift register used to generate the Data In. After n consecutive error-free bits (3 in this example) have been applied to the shift register, the register is synchronized to the Data In.

After the shift register is synchronized, its input is switched to the output of the feedback gate. The Data In is applied as one input to the input gate and the feedback signal is applied as the other. The input gate will produce an output whenever the Data In differs from the output of the feedback gate (i.e., an error is detected).



61.302 **CLOCK**

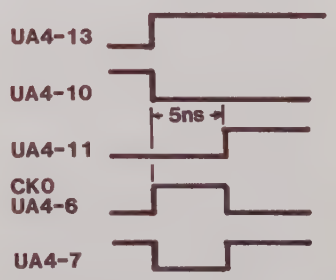
Diagram 61A51

Clock Input

The external clock signal is applied to J502 on the front panel and through J101 to the input of differential amplifier Q101-Q102 which buffers it and converts it to an ECL level referenced to -2V.

Clock Shaper

The clock output from UA5-3 feeds UA4-13. The output from UA4-14 is applied directly to one input of negative and-gate UA4-10. The output from UA4-15 is applied through a 5ns delay line to the second input of UA4 at pin 11. The resultant outputs at pins 6 and 7 are fixed clock pulse widths of 5ns, independent of the input clock frequency.



Clock Distribution — The 5ns clock pulse from UA4-7 is applied to a set of five inverters which provide positive buffered clock outputs CK1 thru CK9 to the other circuits.

One signal, CKO from UA4-6 is used directly from the shaper and one signal, CK2 from UA3-12 is applied via J103 to the 61A54 Interface board.

Clock Status — The positive clock pulse CKO drives a toggle-configured flip-flop UA1 whose output at pin 15 is capacitively coupled to Q107b. Q107 thus responds only to transitions. The output of Q107 drives the CLOCK TRGD front-panel LED. With the proper clock signal applied and at the usual operating frequencies the LED appears lit continuously.

Diagram 61A54

Clock Buffer — The CK2 Clock signal is applied to the Clock Buffer on the 61A54 Interface board and thence from UD5-15 to the 61552 Accumulater via 11XA54-3 and P206.

Diagram 61A52

CLOCK OUT Amplifier — The Clock signal is amplified by Q203 and Q204 and applied via J204 to the CLOCK OUT connector J501 on the Front Panel.

61.303 **DATA**

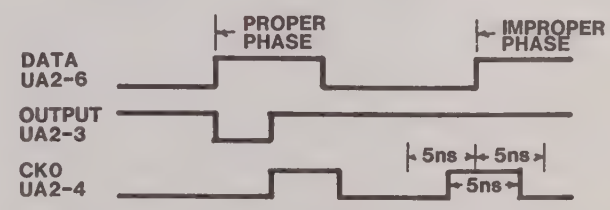
Diagram 61A51

Data Input — The external input signal is applied to J503 on the front-panel and through J102 to the input of differential amplifier Q108 Q109 which buffers it and converts it to an ECL level referenced to -2V.

Data Latch — The buffered data from UB4-7 are applied to the D input of the data latch UB3 at pin 7 and clocked in by CK1. The output of the data latch at UB3 pins 2 and 3 is applied to the input gate and/or the first stage of the shift register.

Data Status — The buffered data from UB4-6 drives a toggle-configured flip-flop UA1 whose output at pin 2 is capacitively couples to Q112b. Q112 thus responds only to transitions. The output of Q112 drives the DATA TRGD front-panel LED. With the proper data signal applied and at the usual operating frequencies the LED appears lit continuously.

Phase Status — The buffered data from UB4-6 clocks D flip-flop UA2, at pin 6 whose D input is always hi via D102 to ground.

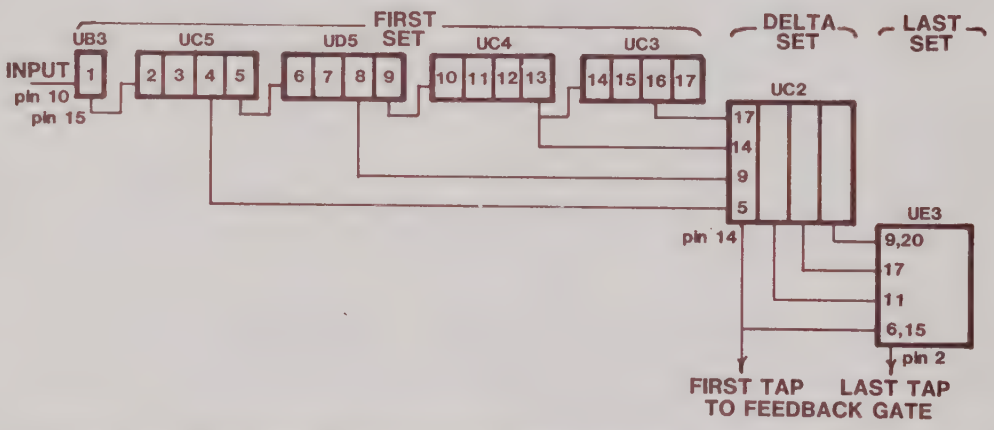


When the data are properly phased with respect to the clock CKO at the reset input at pin 4, the data at the clock input sets the output of UA2 at pin 3 lo and CKO resets it hi. The positive transitions drive a toggle-configured flip-flop whose output at pin 15 is capacitively coupled to Q110. Q110 thus responds only to transitions. The output of Q110 drives the PHASE front-panel LED. With proper phasing between the clock input and data input and at the usual operating frequencies the LED appears lit continuously.

When the data are improperly phased with respect to the clock CKO at the reset input at pin 4 (within 5ns of the positive transition of the clock), the output of UA2 at pin 3 is held hi and not allowed to respond to the data at pin 6. Thus UA2-15 remains a dc level, no transitions reach Q110, and the PHASE LED remains extingushed.

61.304 **SHIFT REGISTER**

Diagram 61A51



In order to eliminate phasing problems caused by device propogation delays, the shift register is reconfigured slightly to include a delta set and a last set.

First Set — The first-set is a normal series of cascaded flip-flops.

Run Status — The Q' output from the first stage of UB3-14 is applied through UB4 whose output at pin 14 is capacitively coupled to Q111b. Q111 thus responds only to transitions. The output of Q111 drives the RUN front-panel LED. When the shift register is running at the usual operating frequencies the LED appears lit continiously.

Delta Set — The delta set is simply another set of cascaded flip-flops that adds from 1 to 4 stages to the register. The first tap from the register to the feedback gate is always connected to the first stage of the delta set.

Last Set — The last set is a single flip-flop that adds 1 stage to the register. The last tap from the register to the feedback is always connected to the output of the last set.

Code	NORMAL		MB-1A	
Length	First Tap	Last Tap	Delta Set	Last Set
6	5	6	4	1
9	5	9	4	4
11	9	11	8	2
15	14	15	13	1
17	14	17	13	3
20	17	20	16	4

In operation, for example, taps at 9 and 11 in a normal register are achieved in this unit by connecting stage 8 of the first set to the delta set input (8+1=9) and connecting the 2nd stage of the delta set to the last set (8+2+1-11).

CODE LENGTH

Inputs to the delta set are controlled by five gates, UE4 (output pins 12,14,15, and 3) and UD3 (output pin 14).

Inputs to the last set are controlled by four gates, UD2 (output pins 2, 14, 15, and 3).

These gates, in turn, are selected by the CODE LENGTH switch S501 via a diode matrix D108 thru D127.

Zero Detection

Because an all-0s state of the shift register would result in a useless, continuing sequence of all 0s, the output of each stage in the shift register is connected to the input of a gate to detect an all -0s condition (UF4-13; UE5-13, -11, -10, -9; UE5-5, -6, -7; UD4-12, UD4-10, -9, -11, UD4-4, -5, UD3-9, -10, -11). The outputs of these gates are applied to UF3 and its output at pin 14 is hi whenever all shift register stages are zero.

Restart

This hi-level is applied through gate UB4, appears at the output pin 2, and sets the first stage of the shift register to 1.

Sync Detection

The information from all stages except the first is applied to UF3 at pins 4 and 6. The third input to UF3 at pin 7 is the 1-state of the first stage of the shift register. When the first stage is 1 and all other stages are 0, UE3 produces a pulse at pin 15.

Diagram 61A53

SYNC OUT Amplifier

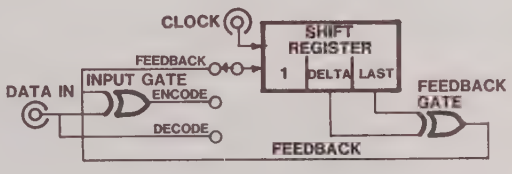
The output from UE3-15 is applied through UE2 and 11 X A54-J to P305 on the 61A53 Counter board where it is amplified by Q303 and Q304 and applied to the SYNC OUT connector, J505 on the Front Panel.

61.305 **ERROR DETECTION**

Diagram 61A51

Feedback Gate

The feedback gate consists of two exclusive-or gates (UD1) with outputs at pins 14 and 15). One input is the first tap of the shift register from the Delta Set UC2-14. The second input is the last tap of the shift register from the Last Set UE3 pins 2 and 3.



Input Gate PN mode

In the PN mode (front-panel PN-FX switch S509 set to PN), the absence of an FX level at UB1-10 allows UE1-2 to go hi, if resync command is true, and enable the input gate at UB2-12. The second input to this gate is the DATA IN signal from front-panel connector J503 via UB3-3. The output of the gate at UB2-2 is the SHIFT IN signal used to drive the shift register. Thus the contents of the shift register becomes the same as the data input.

Error PN Mode

The feedback signal from the feedback gate is applied to a second gate (UD1-3) whose second input at pin 5 is the current data input from the Data Latch UB3-2. Any difference between the first input (feedback signal which is the contents of the shift register) and the second input (current data input) produces an output at UE1-15. This PN Error signal is applied to the 61A54 Interface board via 11AX51-R.

Diagram 61A54

Error Selection Mode — The PN Error signal is buffered by UD5, emerges at pin 5, and is applied to UC4-11 which is enabled by the absence of a lo-level at its second input at pin 10 by the PN setting of S509. The output at UC4-14 appears as the ERROR signal to the 61A52 Accumulator via UB4-15, UC4-9, UD3-14, and 11XA54-10.

Diagram 61A51

Input Gate FX Mode — In the FX mode (front-panel PN-FX switch S509 set to FX) the lo-level FX signal at UB1-10 sets UE1-2 lo which inhibits the input gate at UB2-12. Thus the input to the shift register, and therefore the shift register itself, is inhibited.

Diagram 61A54

Error FX Mode REF DATA IN — The current data input from UB4-7 on the 61A51 PR Generator is applied via 11ZA51-M and 11XA54-D to the Data Buffer and thence to UC3-14. The second input to UC3 at pin 15 is the External Reference DATA IN from J515 on the front panel via the External Reference Data Buffer and UB5-15.

An output at UC3-13 is produced anytime there is a difference between the two inputs; i.e. whenever the data input does not match the external reference.

Error Selection FX Mode — The FX Error signal from UC5-13 is applied to UC4-6 which is enabled by the absence of a lo-level at its second input at pin 7 by the FX setting of S509. The output at UC4-3 appears as the Error signal to the 61A52 Accumulator via UB4-15, UC4-9, UD3-14, and 11XA54-10.

61.306 **SYNCHRONIZATION**

Diagram 61A52

Bit Counter — Clock pulses, representing input data bits, from the 61A51 PR Generator are applied to the Bit Counter at UB3-11 via J206 and UB2-15. The counter consists of UB3, UC4, UD5, UD4, and UD3 with taps at UC5-3 (10-count), UD5-12 (100-count), UD4-12 (1000-count), and UD3-11 (2500 count) and an overflow at UE1-3.

Threshold Counter — Bit errors from the 61A51 PR Generator are applied to the Threshold Error Counter at UB4-11 via J201 and UB5-2. The counter consists of UB4, UE5, UE4 and UE3 with taps at UE5-12 (20-count) and UE3-11 (500 count).

THRESHOLD — When the THRESHOLD switch S502 is set to LO it enables UD1 by ungrounding pin 10, and enables UE1 by ungrounding pin 5. Under these conditions and with a low error rate, the Bit Counter via the Bit Overflow signal at UE1-3 resets before the Error Counter reaches 20.

Similarly, when the THRESHOLD switch S502 is set to HI, the Bit Counter will reach 500 and reset the Error Counter before the Error Counter reaches 2500.

Threshold Error Latch — With a high error rate the Threshold Error Counter will not be reset before it reaches a count of 20 or 500 as determined by the setting of the THRESHOLD switch S502. The Threshold Error Counter will thus overflow and produce a positive transition at UF1-6 and 8. This transition sets the Threshold Error Latch Q output at UF1-5 hi and the Q' output at UF1-6 lo.

The Threshold Error Latch is reset by the Bit Overflow signal from UE1-3 under low error-rate conditions.

Sync Status — The hi-level UF1-5 triggers monostable UF3 which produces a signal at pin 4 that sets flip-flop UF4-9 hi. This hi level energizes the BURST ERROR light-emitting diode on the front-panel.

Out of Sync — The low level from the Threshold Error Latch UF1-6 sets UF4-5 hi and this hi-level is applied via 11AX51-F to the 61A54 Interface board.

Diagram 61A54

OUT OF SYNC Amplifier — The out-of-sync signal is amplified by Q3 and Q4 and applied via 11XA54-X to the OUT OF SYNC connector J512 on the Front Panel.

Diagram 61A52

AUTO Sync — The rising edge Q output from the Error Latch at UF1-5 is also applied to the input of the Resync circuit at UF2-13. This gate is enabled by the AUTO setting of the Sync Mode switch S504.

The output at UF2-8 triggers the Resync circuit which produces a 20-bit Resync signal that is fed directly to the first stage of the Shift Register on the PR Generator board via UB1-15 and J207 (feed-forward operation). After 20 bits have entered the shift register, normal feedback operation is restored and the generator is assumed to be in sync with the incoming PN code (which is true if the 20 bits were error free).

FX Ref Data — With external reference data (PN-FX switch set to FX), a hi-level FX signal from the PN-FX switch S509 on the front panel inhibits UF2 at pin 12. Thus the Auto resync mode is inhibited in the FX mode because the resulting in-sync status would be meaningless since the synchronization circuits cannot affect the synchronization of the external reference generator.

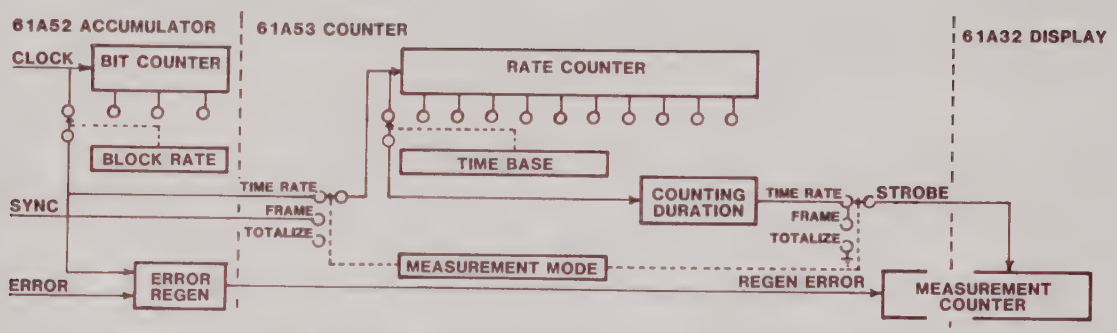
MANUAL Resync — A 20-bit Resync signal is initiated in the same manner as for Auto Resync, by a rising edge from the Manual Sync button S503 in the MANUAL setting of the Sync Mode switch S504 via UF2-4 and -3.

EXT CMMND Resync — A 20-bit Resync signal is initiated, in the same manner as for Auto Resync, by a rising edge from the EXT CMMND input J504 in the EXT CMMND setting of the Sync Mode switch S504 via UF2-10 and 11.

61.307 MEASUREMENTS

Diagram 61A53

General



By means of the Measurement Mode and BLOCK RATE controls, the MB-1A is capable of six different measurements:

BLOCK RATE	Measurement Mode S507		
S505	TOTALIZE	TIME RATE	FRAME
1	Errored Bits	$\frac{\text{Errored Bits}}{\text{Total Bits}}$	$\frac{\text{Errored Bits}}{\text{Total Frames}}$
10,100 or 1000	Errored Blocks	$\frac{\text{Errored Blocks}}{\text{Total Blocks}}$	$\frac{\text{Errored Blocks}}{\text{Total Frames}}$

An errored block is a group of bits (10,100 or 1000 as set by the BLOCK RATE control) in which one or more bits was errored. A frame is a complete sequence of bits of 2^n-1 where n is set by the CODE LENGTH control.

The numerator in the expressions is obtained by simply counting the errors (errored bits or errored blocks). The denominator is obtained by controlling the length of time the counter is allowed to count (in terms of the number of bits, blocks or frames.

Diagram 61A52

Regen Error Gate Bit Errors

The errors detected by the Input gate on the 61A51 PR Generator board are applied to the Regen Error Gate at UB5-10. This gate is enabled by the 1 setting of the BLOCK RATE switch S505. The errors from UB5-14 are applied as the Regen Error signal, via UB5-9 and J203, to the Measurement Counter.

With the BLOCK RATE set to 1, each Regen Error pulse represents an errored bit.

Error Regen Block Errors

For errored blocks (BLOCK RATE set to 10,100 or 1000), UB5-14 is inhibited. The errors detected by the Input Gate on the 61A51 PR Generator board are applied to the Error Regen at the clock input, UB4-6. This produces a transition at UB4-2 which is applied as the Regen Error signal, via UB5-9 and J203, to the Measurement Counter.

The Error Regen is reset by a signal from the Bit Counter applied to UB4-4. This reset signal occurs every 10,100 or 1000 clock pulses, depending on the setting of the BLOCK RATE switch S505. Regardless of how many errors detected, the Error Regen only responds once per block.

With the BLOCK rate set to 10,100 or 1000, each Regen Error pulse represents an errored block.

ERROR OUT Amplifier

The Regen Error signals are also applied to the Error Out Amplifier at Q201-e and thence to the ERROR OUT connector J506 on the Front Panel.

Diagrams 61A53, 61A54, 61A32

Measurement Counter TOTALIZE

The Regen Error Signal is applied to the first stage of the Measurement Counter at UC1-12 on the 61A53 Counter board. UC1 drives the least-significant digit, UB7, on the 61A32 Display board. UB7 thru UB4 (thru UB2 with Option or Extended Resolution) count and display the Regen Error Pulses.

When the Measurement Mode switch S507 is set to TOTALIZE, the Strobe signal is set lo at UF1-6, inverted to a hi level by UB1-8 on the 61A54 Interface, and applied to UC2-9 on the 61A32 Display board. UC2 inverts the signal and applies it as a lo level to the Measurement Counter which allows the counter to count.

In TOTALIZE, the Measurement Counter is allowed to count the incoming Regen Error pulses indefinitely.

Diagram 61A53

Rate Counter

The input to the Rate Counter at UB6-7 is selected by the Measurement Mode switch S507 as either the Regen Clock signal from the 61A52 Accumulator (representing either bits or blocks) or the Frame Sync signal (representing frames).

Counting Duration

The output from the Rate Counter is counted down by a factor of 10^{0} thru 10^{10} as by the Time Base switch S508 and is applied to the Counting Duration circuit at UB3-9.

Strobe

The output of the Counting Duration circuit is the Strobe signal at UF1-6. This signal is applied, via UB1-8 on the 61A54 Interface board, to the Measurement Counter and controls the counting operation.

Measurement Start TIME BASE, FRAME

In the TIME BASE or FRAME mode, the first input to the Rate Counter sets the Strobe signal lo which applies a lo level Latch signal to the Measurement Counter strobe inputs and allows the counters to count.

Measurement Stop TIME BASE, FRAME	The Rate Counter produces a second output at UB3-9 when it has counted the number of pulses as set by the TIME BASE switch S508 (from 1 to 10,000,000,000). Upon the second input at UB3-9 the Strobe signal goes lo which inhibits the Measurement Counter.
TIME BASE OUT Amplifier	A second output from the Rate Counter at UB5-2 is applied to the Time Base Out Amplifier at Q301-e and thence to the TIME BASE OUT Connector J508 on the Front Panel.

61.308 **REGULATORS**

Diagram 61A22

Unregulated + and -17V from the mainframe power supply is applied to P603 pins 4 and 16 and 6 and 18 respectively. Regulators VR601 and VR602 connected to these pins provide regulated +5V and -5.2V for the circuits in the module. Q601 and Q602 provide additional current capacity by shunting the regulators.

61.400 CONTENTS

61.401 Routine Service.....page 61-401
61.402 Repair Returns..... 61-401
61.403 Test Procedure..... 61-401

61.401 ROUTINE SERVICE

None required.

61.402 REPAIR RETURNS

To return a unit for repair:

1. Call the Customer Service Dept., (617)256-9013, for a Repair Authorization Number. This will reduce administrative delays and ensure prompt return of your unit.
2. Complete and attach the Repair Tag, in the rear of the manual, to your unit for positive identification.
3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb) and shock absorbing material such as bubblewrap to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.
4. Send to: Tau-Tron
   27 Industrial Ave.
   Chelmsford, MA 01824
   Attn: Customer Service

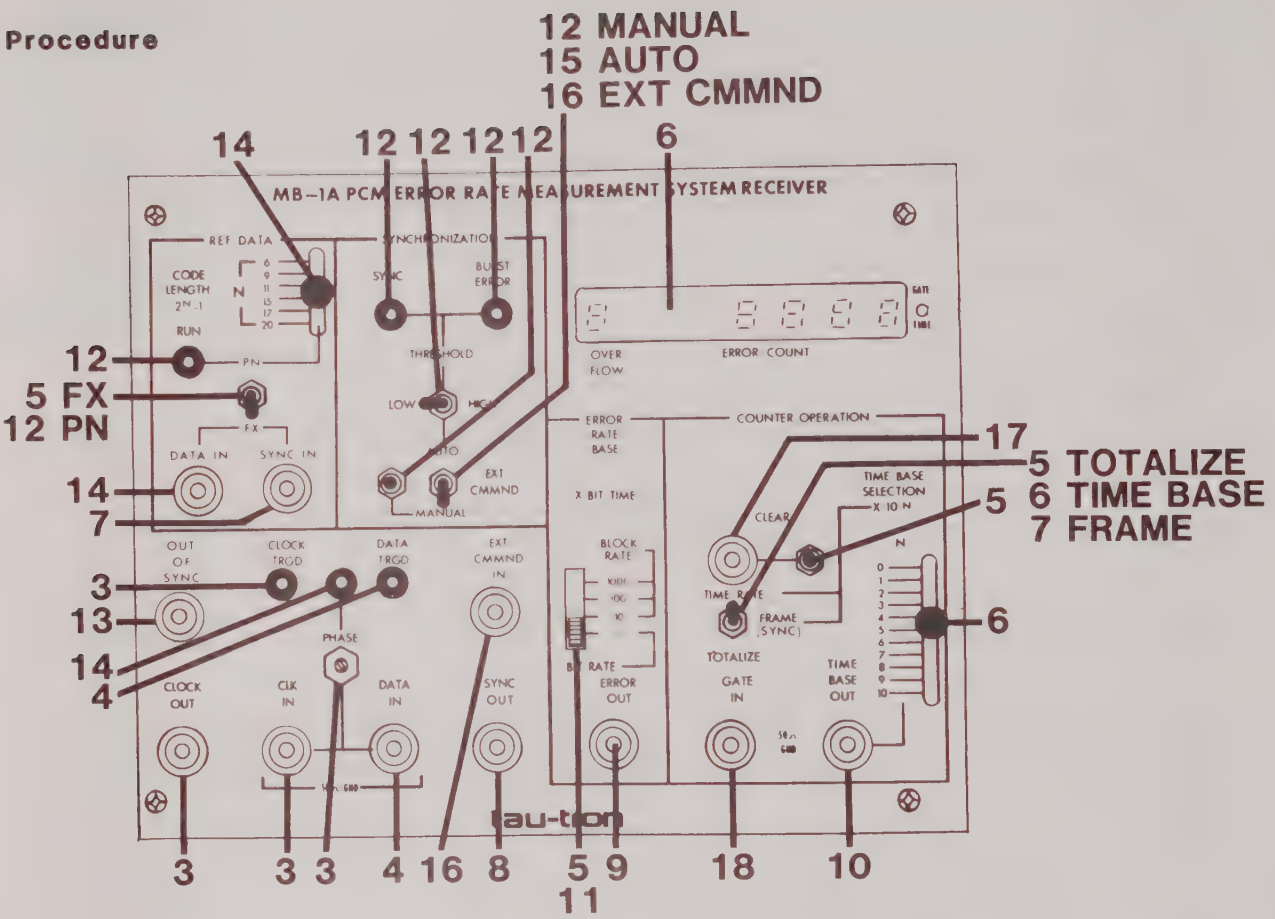
61.403 TEST PROCEDURE

Equipment

The specifications given are those necessary to perform the tests and are not necessarily those of the suggested equipment.

a. Mainframe	Tau-Tron Modular Instrument (TMI) MF-2, MF-3, or MF-5 Mainframe.
b. Oscillator	1kHz to 75MHz, 2V p-to-p output. Tau-Tron MS-101.
c. Generator	Pseudorandom data generator, 1kHz to 75MHz, 2V p-to-p output, with sequence lengths of 2^6-1, 2^9-1, 2^{11}-1, 2^{15}-1, 2^{17}-1, and 2^{20}-1. Tau-Tron MN-1.
d. Autotransformer	Capable of varying input ac line ±10%, 300W, with output ac voltmeter. Variac W5MT3VM (115V line) or Variac W5HMT with seperate voltmeter (230V line).
e. Voltmeter	4.2 to 5.3Vdc, 5000Ω/V. Triplett 630.
f. Oscilloscope	1.8ns risetime, 25mV to 2V/div sensitivity. Tektronix 475.
g. 50Ω termination	50Ω termination with BNC connectors. Kings 1340-1.

Procedure



	Initial setup	Turn off the mainframe, remove all modules, and connect the mainframe to a variable ac line. Insert the MB-1A into the far right-hand position of the mainframe.
1	+5V Supply	Connect a dc voltmeter and an oscilloscope to the output of the +5V regulator (VR601 emitter pin 2). Set the ac line for the nominal supply voltage (100, 115, 200, 230 or 250V) and turn on the mainframe power. The +5V supply must be +4.9 to +5.1V and ripple must be 50mV p-to-p max, 120 Hz. Reduce the line voltage to the low end (90, 105, 115, 180, 210 or 230). The +5V supply must remain within 0.1V of +5 and ripple must remain at or below 50mV p-to-p. Increase the line voltage to the high end (110, 125, 135, 220, 250 or 270). The +5V supply must remain with 0.1V of +5V and ripple must remain at or below 50mV p-to-p.
2	-5.2V Supply	Change the dc voltmeter and oscilloscope to the output of the -5.2V regulator (VR602 emitter pin 2).

Set the ac line for the moninal line voltage. The -5.2V supply must be -5.1 to -5.3V and ripple must be 50mV p-to-p max, 120Hz.

Reduce the line voltage to the low end. The -5.2V supply must remain within 0.1V of -5.2V and ripple must remain at or below 50mV p-to-.

Increase the line voltage to the high end. The -5.2V supply must remain within 0.1V of -5.2V and ripple must remain at or below 50mV p-to-p.

Disconnect the voltmeter and oscilloscope from the output of the -5.2V regulator and return the line voltage to its nominal value.

3 CLOCK IN, CLOCK TRIGD, CLOCK OUT, PHASE adjust

Clock Source .....Connect one output to input of oscilloscope, terminated in 50Ω, set source to 1MHz, and trigger oscilloscope from this input.

CLK IN.....Connect to MN-1 CLOCK OUT, terminated in 50Ω at MB-1A CLK IN.

CLOCK OUT.....Connect to second input of oscilloscope terminated in 50Ω at oscilloscope.

CLOCK TRGD indicator must light when input clock signal is connected.

Vary input clock frequency from 1kHz to 75MHz. CLOCK OUT amplitude must be 1.7 to 2.3V p-to-p and duration must be 5ns min.

Set input clock frequency to 10MHz and vary PHASE adjust from fully ccw to fully cw CLOCK OUT delay with respect to clock output, must have a range of at least 30ns from minimum delay to maximum delay. Set PHASE fully ccw.

Disconnect CLOCK OUT from oscilloscope.

4 DATA IN, DATA TRGD

DATA IN.....Connect to MN-1 SYNC OUT
CLK IN .....Leave at MN-1 CLOCK OUT.

Set clock source to 1kHz and MN-1 for a pseudorandom sequence output of 2^9-1 (511-bit sequence) or approximately 2 pulses per second.

DATA TRGD indicater must blink at a rate of approximately 2 times per second when input data signal is connected.

5 FX, TOTALIZE, CLEAR

Measurement Mode.....TOTALIZE
PN-FX.....FX
BLOCK RATE.....I
DATA IN.....Leave at MN-1 SYNC OUT
CLK IN.....Leave at MN-1 CLOCK OUT

In FX, errors are determined by comparing the DATA IN signal (approximately 2 pulses per second) to the REF DATA IN signal (no connection; i.e., all zeros). An error is generated, therefore, for each pulse applied to the DATA IN connector.

The display must register an error (ERROR COUNT updated by one) at a rate of approximately 2 per second.

Push and hold the CLEAR button. The display must read zero.

Release the CLEAR button. The display must again register errors at a rate of approximately 2 per second.

6 TIME BASE, display

Measurement Mode.....TIME RATE
TIME BASE.....0
DATA IN.....Connect to MN-1 DATA OUT
BLOCK RATE.....Leave at 1.
PN-FX.....Leave at FX.
CLK IN.....Leave at MN-1 CLOCK OUT

Set the clock source to 10MHz and the MN-1 for a pseudorandom sequence of 2^6-1 (63-bit sequence).

With these settings the error rate is slightly greater then the 0.5 (every other bit is in error) and the measurement duration is 1 clock period (10^0=1). The display will therefore read 0 for some measurements and 1 for others.

Change the TIME BASE as follows and check for the display indicated:

TIME BASE	Normal Resolution 4 digits	OP-07 Extended Resolution 6 digits
1	5	5
2	50±2	50±2
3	507±2	507±2
4	5079±2	5079±2
5	10793±2	50793±2
6	17936±2	507936±2
7	19365±2	1079365±2
8	13650±2	1793650±2
9	16507±2	1936507±2
10	15079±2	1365079±2

7 FRAME, SYNC IN

SYNC IN.....Connect to MN-1 SYNC OUT
Measurement Mode.....FRAME
TIME BASE.....0
DATA IN.....Leave at MN-1 DATA OUT
BLOCK RATE .....Leave at 1
PN-FX.....Leave at FX
CLK IN.....Leave at MN-1 CLOCK OUT

Leave the clock source set to 10MHz and the MN-1 set for a pseudorandom sequence of 2^6-1 (63-bit sequence). The display must read 32.

8 SYNC OUT

SYNC OUT.....Connect to second input of oscilloscope terminated in 50Ω at oscilloscope.
SYNC IN.....Leave at MN-1 SYNC OUT
Measurement Mode.....Leave at FRAME
TIME BASE.....Leave at 0
DATA IN.....Leave at MN-1 DATA OUT
BLOCK RATE .....Leave at 1
PN-FX.....Leave at FX
CLK-IN.....Leave at MN-1 CLOCK OUT

Vary the input clock frequency from 1kHz to 75MHz. The SYNC OUT amplitute must be 1.7V p-to-p min and the duration must be one clock period.

Disconnect SYNC OUT from oscilloscope and SYNC IN from MN-1 SYNC OUT.

9 ERROR OUT

ERROR OUT.....Connect to second input of oscilloscope, terminated in 50Ω at oscilloscope.
TIME BASE.....10
Measurement Mode.....Leave at FRAME
DATA IN.....Leave at MN-1 DATA OUT
BLOCK RATE.....Leave at 1
PN-FX.....Leave at FX
CLK IN.....Leave at MN-1 CLOCK OUT

Vary the input clock frequency from 1kHz to 75MHz. The ERROR OUT amplitude must be 5ns min, and the pattern must not vary with frequency.

Disconnect ERROR OUT from oscilloscope.

10 TIME BASE

TIME BASE OUT.....Connect to second input of oscilloscope, terminated in 50Ω at oscilloscope.
Measurement Mode.....TIME BASE
DATA IN.....Leave at MN-1 DATA OUT
BLOCK RATE.....Leave at 1
PN-FX.....Leave at FX
CLK IN.....Leave at MN-1 CLOCK OUT

Vary the input clock frequency from 1kHz to 75MHz. The TIME BASE OUT amplitude must be 1.7 to 2.3V p-to-p.

Set the input clock frequency to about 10MHz and the TIME BASE control to 0. The TIME BASE OUT must be 1 clock period. Change the TIME BASE control to 1. The TIME BASE OUT must be 10 clock periods.

Vary the TIME BASE control from 1 to 10. The TIME BASE OUT duration must increase with each higher setting of the TIME BASE control.

Disconnect TIME BASE OUT from oscilloscope.

11 BLOCK RATE

TIME BASE.....10
Measurement Mode.....Leave at TIME BASE
DATA IN.....Leave at MN-1 DATA OUT
BLOCK RATE.....Leave at 1
PN-FX.....Leave at FX
CLK IN.....Leave at MN-1 CLOCK OUT

Leave the input clock frequency at 10MHz and the MN-1 set for a pseudorandom sequence of 2^6-1 (63-bit sequence).

Change the BLOCK RATE as follows and check for the display indicated:

BLOCK RATE	Normal Resolution 4 digits	OP-07 Extended Resolution 6 digits
1	1 5079±2	1 365079±2
10	1 6570±2	1 936507±2
100	1 3650±2	1 793650±2
1000	1 9365±2	1 079365±2

Disconnect DATA IN and CLK IN.

12 RUN, MANUAL Sync, SYNC, BURST ERROR, THRESHOLD

CLK IN.....Connect to MN-1 SYNC OUT
Measurement Mode.....TOTALIZE
Sync Mode.....MANUAL
THRESHOLD.....LOW
PN-FX.....PN
CODE LENGTH.....6
BLOCK RATE.....Leave at 1.

Set input clock frequency to approximately 1kHz and set MN-1 for a pseudorandom sequence of 2^9-1 (511-bit sequence).

The RUN indicator must blink on and off at a rate of approximately 2 times a second.

In PN, errors are determined by comparing the output of the internal pseudorandom generator (approximately 2 bits per second) to the DATA IN signal (no connection; i.e., all zeros). An error is generated, therefore, for each 1-bit generated by the internal pseudorandom generator.

Push and hold the MANUAL sync button for several seconds. The SYNC indicator must light and stay lit after the MANUAL sync button is released.

When the MANUAL sync button is released, the display will begin to accumulate counts. When the count reaches 20, the SYNC indicator must extinguish and the BURST ERROR indicator must light.

Push the CLEAR button and set the THRESHOLD to HIGH. Push and hold the MANUAL sync button for several seconds. The BURST ERROR indicator must extinguish and the SYNC indicator must light and stay lit after the MANUAL sync button is released.

When the MANUAL sync button is released, the display will begin to accumulate counts. When the count reaches 500 (the input clock frequency may be increased to reduce the counting time), the SYNC indicator must extinguish and the BURST ERROR indicator must light.

13 OUT OF SYNC

OUT OF SYNC.....Connect to second input of oscilloscope, terminated in 50Ω at oscilloscope.
THRESHOLD.....HIGH
CLK IN.....Leave at MN-1 SYNC OUT
Measurement Mode.....Leave at TOTALIZE
Sync Mode.....Leave at MANUAL
PN-FX.....Leave at PN
CODE LENGTH.....Leave at 6
BLOCK RATE.....Leave at 1

Keep the MN-1 set for a psuedorandom sequence of 2^9-1 and set the input clock frequency for a rate that provides a convenient counting time.

Push and hold the MANUAL sync button for a second or two. When the BURST ERROR extinguishes and the SYNC indicator lights, the OUT OF SYNC amplitude must be a dc level of 0 to 0.2V.

When the BURST ERROR indicator lights and the SYNC indicator extinguishes (after 500 error counts), the OUT OF SYNC amplitude must be a dc level of 1.7 to 2.3V.

Disconnect OUT OF SYNC from oscilloscope and CLK IN from MN-1 SYNC OUT.

14 DATA IN PHASE, CODE LENGTH

DATA IN.....Connect to MN-1 DATA OUT
CLK IN.....Connect to MN-1 CLOCK OUT
Measurement Mode.....Leave at TOTALIZE
Sync Mode.....Leave at MANUAL
THRESHOLD.....Leave at HIGH
PN-FX.....Leave at PN
CODE LENGTH.....Leave at 6
BLOCK RATE.....Leave at 1

Set the input clock frequency to 1kHz and set the MN-1 for a pseudorandom sequence of 2^6-1.

The CLOCK TRGD, DATA TRGD, and PHASE indicator must all light.

Momentarily push the MANUAL sync button, the BURST ERROR indicator must extinguish and the SYNC indicator must light. Momentarily push the CLEAR button to clear the display. Vary the input clock frequency from 1kHz to 75MHz. This display must remain 0. Momentarily push the TEST button on the MN-1 to introduce errors. The display must register the count (if the TEST button is depressed too long, the errors will exceed 500 and the MB-1A will have to be manually resync'd).

Repeat this procedure for each setting of the CODE LENGTH switch. For each setting, the MN-1 must be set to the same length and the MB-1 must be set to the same length and the MN-1B must be resync'd.

15 AUTO Sync

CODE LENGTH.....6
Sync Mode.....AUTO
THRESHOLD.....Leave at HIGH
DATA IN.....Leave at MN-1 DATA OUT
CLK IN.....Leave at MN-1 CLOCK OUT
Measurement Mode.....Leave at TOTALIZE
PN-FX.....Leave at PN
BLOCK RATE.....Leave at 1

Set input clock frequency to 75MHz and set the MN-1 for a pseudorandom sequence of 2^6-1. The BURST ERROR indicator must be extinguished and the SYNC indicator must be lit.

Push the TEST button on the MN-1 for a second or so. While the TEST button is pushed, the BURST ERROR indicator must be lit and the SYNC indicator must be extinguished. After the TEST button is released, the BURST ERROR indicator must extinguish and the SYNC indicator must light.

16 EXT CMMND

OUT OF SYNC.....Connect a cable terminated in 50Ω
Sync Mode.....EXT CMMND
THRESHOLD.....Leave at HIGH
CODE LENGTH.....Leave at 6
DATA IN.....Leave at MN-1 DATA OUT
CLK IN.....Leave at MN-1 CLOCK OUT
Measurement Mode.....Leave at TOTALIZE
PN-FX.....Leave at PN
BLOCK RATE.....Leave at 1

Set input clock frequency to 10MHz and set the MN-1 for a pseudorandom sequence of 2^6-1. Push the TEST button on the MN-1 for an out-of-sync condition on the MB-1A (BURST ERROR lit, SYNC extinguished).

Momentarily connect the OUT OF SYNC to the EXT CMMND IN. The MN-1 should resync (BURST ERROR extinguished, SYNC lit).

17 CLEAR

OUT OF SYNC.....Leave cable connected
Sync Mode.....Leave at EXT CMMND
THRESHOLD.....Leave at HIGH
CODE LENGTH.....Leave at 6
DATA IN.....Leave at MN-1 DATA OUT
CLK IN.....Leave at MN-1 CLOCK OUT
Measurement Mode.....Leave at TOTALIZE
PN-FX.....Leave at PN
BLOCK RATE.....Leave at 1

Keep input clock frequency at 10MHz and MN-1 set for a pseudorandom sequence of 2^6-1. Push the TEST button on the MN-1 for an out-of-sync condition on the MB-1A so that the display is accumulating counts.

Connect the OUT OF SYNC to the CLEAR input connector. The display must read zero.

Disconnect the cable from the CLEAR input connector. The display must again accumulate counts.

18 GATE IN

OUT OF SYNC.....Leave cable connected.
Sync Mode.....Leave at EXT CMMND
THRESHOLD.....Leave at HIGH
CODE LENGTH.....Leave at 6
DATA IN.....Leave at MN-1 DATA OUT
CLK IN.....Leave at MN-1 CLOCK OUT
Measurement Mode.....Leave at TOTALIZE
PN-FX.....Leave at PN
BLOCK RATE.....Leave at 1

Keep input clock frequency at 10MHz and MN-1 set for a pseudorandom sequence of 2^6-1. Push the TEST BUTTON on the MN-1 for an out-of-sync condition on the MB-1A so that the display is accumulating counts.

Connect the OUT OF SYNC to the GATE IN connector. The display must stop accumulating counts (measurement inhibited).

Disconnect the cable from the GATE IN connector. The display must again accumulate counts.

END

61.500 **CONTENTS**

61.501 Replaceable Parts.....61-501

61.501 **REPLACEABLE PARTS**

Reference designations include unit and assembly prefixes.

Ref Des		Description	Tau-Tron No.
61A11		**FRAME**	
61A11		Rails, four rails total, supplied in sets of two each (top and bottom), per set.....	9705-4018B
61A11		Shield, formed aluminum..... Secured to rails by four 5-40X.25in. Phillips-head screws	9705-3395
61A21		**REAR PANEL**	
61A21		Panel only, drilled, without components..... Secured to rails by four 5-40X3/8in. Phillips-head machine screws	
61A21	J606	Connector 50-pin male, Amphenol 57-30500.....	9300-0094
61A22		**REGULATOR**	
61A22	C602	Capacitor, 20% 200V,.1μF ceramic.....	1014-4610
61A22	C603	Capacitor, 20% 35V, 1μF tantalum.....	1024-5110
61A22	C604	Capacitor, 20% 35V, 4.7 μF tantalum.....	1024-5147
61A22	C605	Capacitor, 20% 35V, 1μF tantalum.....	1024-5110
61A22	C606	Capacitor, 20% 35V, 10μF electrolytic.....	1024-5210
61A22	Q601	Transistor, 2N5301.....	3180-5301
61A22	Q602	Transistor, MJ2955.....	3180-2955
61A22	P603	Plug, 24-pin male, chassis mounted.....	9300-0103
61A22	R601	Resistor, 100Ω ±5% ¼W composition.....	0022-3100
61A22	R602	Resistor, 3Ω ±5% ¼W composition.....	0022-1300
61A22	R603	Resistor, 300Ω ±5% ¼W composition.....	0022-3300
61A22	R604	Resistor, 12Ω ± 5% ¼W composition.....	0022-2120
61A22	R605	Resistor, 3Ω ±5% ¼W composistion.....	0022-1300
61A22	VR601	Voltage regulator, LM340K-05, +5V..... Uses Keystone 4606 TO-3 mounting socket Thermalloy 4726A to-3 annodized aluminum heat sink Two Motorola B515475002 nylon bushings Secured with two 6-32X½ in. slotted hex-head self-tapping screws	4200-340K5

Ref Des		Description	Tau-Tron No.
61A22	VR602	Voltage regulator, LM320K-5.0,-5.2V..... Uses Keystone 4606 TO-3 mounting socket Thermalloy 4726A TO-3 annodized aluminum heat sink Two Motorola B515475002 nylon bushings Secured with two 6-32X½in. slotted hex-head self-tapping screws	4200-320K5
61A31		**FRONT PANEL**	
61A31		Panel only, drilled, painted, silk-screened, without components..... Secured to rails by four 5-40X3/8in. Phillips-head machine screws	9705-3500
61A31	DS501	RUN,light-emitting diode, ...	2274-5053
61A31	DS502	SYNC light-emitting diode, ...	2274-5053
61A31	DS503	BURST ERROR light-emitting diode,.....	2274-5053
61A31	DS504	CLOCK TRGD light-emitting diode, ...	2274-5053
61A31	DS505	PHASE light-emitting diode,.....	2274-5053
61A31	DS506	DATA TRGD light-emitting diode,.....	2274-5053
61A31	J501	CLOCK OUT connector, BNC female;.....	9301-0001
61A31	J502	CLK IN connector, BNC female;	9301-0001
61A31	J503	DATA IN connector, BNC female;	9301-0001
61A31	J504	EXT CMMND IN connector, BNC female;	9301-0001
61A31	J505	SYNC OUT connector, BNC female;.....	9301-0001
61A31	J506	ERROR OUT connector, BNC female;.....	9301-0001
61A31	J507	GATE IN connector, BNC female,.....	9301-0001
61A31	J508	TIME BASE OUT connector, BNC female;	9301-0001
61A31	J512	OUT OF SYNC connector, BNC female;.....	9301-0001
61A31	J513	CLEAR connector, BNC female;	9301-0001
61A31	J514	SYNC IN connector, BNC female, ...	9301-0001
61A31	J515	DATA IN connector, BNC female;	9301-0001
61A31	R501	PHASE potentiometer, 5kΩ.....	0333-4500B
61A31	R502	Resistor, 24KΩ ±5 1/8W, carbon composition.....	0012-5470
61A31	S501	CODE LENGTH switch, 11-position slide..... Uses Knob; Also KSS-3B.....	9201-0001 9800-KSS3B
61A31	S502	THRESHOLD switch, spdt toggle.....	9200-0005
61A31	S503	MANUAL sync switch, pushbutton.....	9203-0000
61A31	S504	EXT CMMND switch, 3-position toggle.....	9200-0009
61A31	S505	CLOCK RATE switch , 4-position slide.....	9201-0003
61A31	S506	CLEAR switch, pushbutton.....	9203-0000
61A31	S507	Measurement Mode switch, 3-position toggle.....	9200-0001
61A31	S508	CODE LENGTH, 11-position slide..... Uses knob; Also KSS-3B.....	9201-0001 9800-KSS3B
61A31	S509	PN-FX switch, spdt toggle.....	9200-0005
61A31	DS509	Diode.....	2112-4148
61A32		**DISPLAY**	
61A32	C1	Capacitor, 20% 10V, 33 µF 10V miniature tantalum.....	1064-1233
61A32	C501	Capacitor, 20% 50V, .01µF chip bypass.....	1084-4710
61A32	C502	Capacitor, 20% 50V, .01µF chip bypass.....	1084-4710

Ref Des		Description	Tau-Tron No.
61A32	DS1	GATE light-emitting diode, ...	2274-MV50
61A32	J505	Connector, for circuit boards, 16-pin; mates with 61A11 P505.....	9300-0030
61A32	J506	, for rear connector J606, 16-pin; mates with 61A21 P506.....	9300-0030
61A32	J507	, for rear connector J606, 16-pin; mates with 61A21 P507.....	9300-0030
61A32	R1	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
61A32	R2	Resistor, 2kΩ ±5% 1/8W composition.....	0012-4200
61A32	R3	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
61A32	UB1	Integrated circuit, ...	4513-0304
61A32	UB2	OP-07 only: Integrated circuit, ...	4513-0306
61A32	UB3	OP-07 only: Integrated circuit, ...	4513-0306
61A32	UB4	Integrated circuit, ...	4513-0306
61A32	UB5	Integrated circuit, ...	4513-0306
61A32	UB6	Integrated circuit, ...	4513-0308
61A32	UB7	Integrated circuit, ...	4513-0308
61A32	UC1	Integrated circuit, ...	4012-7476
61A32	UC2	Integrated circuit, ...	4012-74H04
61A32	UC3	Integrated circuit, ...	4012-74196
61A32	UC4	Integrated circuit, ...	4012-74H00
61A51		**PR GENERATOR**	
61A51	C101	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A51	C102	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A51	C103	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A51	C105	Capacitor, 20% 6V, 47μF miniature tantalum.....	1064-0847
61A52	C106	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A51	C107	Capacitor, 20% 6V, 47μF miniature tantalum.....	1064-0847
61A51	C108	Capacitor, 20% 6V, 47μF miniature tantalum.....	1064-0847
61A51	C109	Capacitor, 20% 6V, 47μF miniature tantalum.....	1064-0847
61A51 thru 61A51	C110 thru C116	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A51	C122	Capacitor, 20% 10V, 33μF miniature tantalum.....	1064-1233
61A51	C123	Capacitor, 20% 10V, 33μF miniature tantalum.....	1064-1233
61A51 thru 61A51	C501 thru C554	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A51 thru 61A51	D101 thru D127	Diode, ...	2112-4148
61A51 thru 61A51	D150 thru D152	Diode, ...	2112-4148
61A51	DL1	Delay line, 5ns	
61A51	DL2	Delay line, 7.5ns	

Ref Des	Description	Tau-Tron No.
61A51 J101	Connector, for clock in;	9301-0060
61A51 J102	Connector, for data in;	9301-0060
61A51 J103	Connector, for clock out;	9301-0060
61A51 J104	Connector, for resync,	9301-0060
61A51 J105	Connector, for front-panel connections, 16-pin	9300-0030
61A51 Q101	Transistor,	3224-5771
61A51 Q102	Transistor,	3224-5771
61A51 Q107 thru 61A51 Q112	Transistor,	3224-5771
61A51 R101	Resistor, 51Ω 5% 1/8W composition	0012-2510
61A51 R102	Resistor, 100Ω 5% 1/8W composition	0012-3100
61A51 R103	Resistor, 130Ω ±5% 1/8W composition	0012-3130
61A51 R104	Resistor, 100Ω ±5% 1/8W composition	0012-3100
61A51 R105	Resistor, 390Ω ±5% 1/8W composition	0012-3390
61A51 R106	Resistor, 100Ω ±5% 1/8W composition	0012-3100
61A51 R107	Resistor, 240Ω ±5% 1/8W composition	0012-3240
61A51 R108	Resistor, 300Ω ±5% 1/8W composition	0012-3300
61A51 R110	Resistor, 200Ω ±5% 1/8W composition	0012-3200
61A51 R111	Resistor, 240Ω ±5% 1/8W composition	0012-3240
61A51 R112	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A51 R113	Resistor, 7.5Ω ±5% 1/8W composition	0012-4750
61A51 R114	Resistor, 20Ω ±5% 1/8W composition	0012-2200
61A51 R115	Resistor, 51Ω ±5% 1/8W composition	0012-2510
61A51 R116	Resistor, 100Ω ±5% 1/8W composition	0012-3100
61A51 R117	Resistor, 130Ω ±5% 1/8W composition	0012-3130
61A51 R118	Resistor, 100Ω ±5% 1/8W composition	0012-3100
61A51 R119	Resistor, 100Ω ±5% 1/8W composition	0012-3100
61A51 R120	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A51 R121	Resistor, 7.5Ω ±5% 1/8W composition	0012-4750
61A51 R122	Resistor, 20Ω ±5% 1/8W composition	0012-2200
61A51 R123	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A51 R124	Resistor, 7.5Ω ±5% 1/8W composition	0012-4750
61A51 R125	Resistor, 20Ω ±5% 1/8W composition	0012-2200
61A51 R126	Resistor, 68Ω ±5% 1/8W composition	0012-2680
61A51 R127	Resistor, 390Ω ±5% 1/8W composition	0012-3390
61A51 R128	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A51 R129	Resistor, 7.5Ω ±5% 1/8W composition	0012-4750
61A51 R130	Resistor, 20Ω ±5% 1/8W composition	0012-2200
61A51 R131 thru 61A51 R134	Resistor, 68Ω ±5% 1/8W composition	0012-2680
61A51 R135 thru 61A51 R147	Resistor, 100Ω ±5% 1/8W composition	0012-2680
61A51 R148	Resistor, 68Ω ±5% 1/8W composition	0012-2680
61A51 R149	Resistor, 51Ω ±5% 1/8W composition	0012-2510
61A51 R152	Resistor, 160Ω ±5% 1/8W composition	0012-3160
61A51 R191	Resistor, 390Ω ±5% 1/8W composition	0012-3390
61A51 R192	Resistor, 75Ω ±5% 1/8W composition	0012-2750
61A51 R193	Resistor, 390Ω ±	

Ref Des		Description	Tau-Tron No.
61A51	R194	Resistor, 51Ω ±5%1/8W composition.....	0012-2510
61A51	R195	Resistor, 130Ω ±5% 1/8W composition.....	0012-3130
61A51	R196	Resistor, 82Ω ±5% 1/8W composition.....	0012-2820
61A51	R197	Resistor, 82Ω ±5% 1/8W composition.....	0012-2820
61A51	R198	Resistor, 130Ω ±5% 1/8W composition.....	0012-3130
61A51	R199	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R200	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R201	Resistor, 82Ω ±5% 1/8W composition.....	0012-2820
61A51	R202	Resistor, 130Ω ±5% 1/8W composition.....	0012-3130
61A51	R203 thru R207	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A51	R208	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
61A51	R209	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A51	R210	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
61A51	R211	Resistor, 240Ω ±5% 1/8W composition.....	0012-3240
61A51	R501 thru R528	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R530 thru R533	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R538 thru R553	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R555 thru R563	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R565 thru R576	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R580	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R604	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R605	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R606	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A51	R607	Resistor, 160Ω ±5% 1/8W composition.....	0012-3160
61A51	UA1	Integrated circuit,.....	4012-01031
61A51	UA2	Integrated circuit,.....	4012-01031
61A51	UA3	Integrated circuit,.....	4012-10211
61A51	UA4	Integrated circuit,.....	4012-10105
61A51	UA5	Integrated circuit,.....	4012-1670

Ref Des	Description	Tau-Tron No.
61A51 UB1	Integrated circuit,.....	4012-10105
61A51 UB2	Integrated circuit,.....	4012-1662
61A51 UB3	Integrated circuit,.....	4012-10131
61A51 UB4	Integrated circuit,.....	4012-10105
61A51 UC1	Integrated circuit,.....	4012-1660
61A51 UC2 thru 61A51 UC5	Integrated circuit,.....	4012-10141
		4012-10141
61A51 UD1	Integrated circuit,.....	4012-1672
61A51 UD2	Integrated circuit,.....	4012-10102
61A51 UD3	Integrated circuit,.....	4012-10105
61A51 UD4	Integrated circuit,.....	4012-10105
61A51 UD5	Integrated circuit,.....	4012-10141
61A51 UE1	Integrated circuit,.....	4012-10131
61A51 UE2	Integrated circuit,.....	4012-10101
61A51 UE3	Integrated circuit,.....	4012-10131
61A51 UE4	Integrated circuit,.....	4012-10102
61A51 UE5	Integrated circuit,.....	4012-10109
61A51 UF3	Integrated circuit,.....	4012-10109
61A51 UF4	Integrated circuit,.....	4012-10102
61A51 UF5	Integrated circuit,.....	4012-10102
61A52	**ACCUMULATOR**	
61A52 C201	Capacitor, 20% 50V, .01µF chip bypass.....	1084-4710
61A52 C202	Capacitor, 10% 200V, 47pF ceramic.....	1013-8247
61A52 C203	Capacitor, 20% 50V, .01µF chip bypass.....	1084-4710
61A52 C204	Capacitor, 10% 200V, 47µpF ceramic.....	1013-8247
61A52 C205	Capacitor, 10% 200V, 100pF ceramic.....	1013-8310
61A52 C206	Capacitor, 10% 200V, 1000pF ceramic.....	1014-8410
61A52 C207	Capacitor, 20% 200V, 1000pF ceramic.....	1014-8410
61A52 C208	Capacitor, 20% 50V, .01µF chip bypass.....	1084-4710
61A52 C209	Capacitor, 20% 200V, 1000pF ceramic.....	1014-8410
61A52 C210	Capacitor, 20% 50V, .01µF chip bypass.....	1084-4710
61A52 C211	Capacitor, 20% 50V, .01µF chip bypass.....	1084-4710
61A52 C212	Capacitor, 10% 200V, 47pF ceramic.....	1013-8247
61A52 C291	Capacitor, 20% 10V, 33µF miniature tantalum.....	1064-1233
61A52 C292	Capacitor, 20% 10V, 33µF miniature tantalum.....	1064-1233
61A52 C501 thru 61A52 C530	Capacitor, 20% 50V, .01µF chip bypass.....	1084-4710
D201	Diode.....	2112-4148

Ref Des		Description	Tau-Tron No.
61A52	J201	Connector, for error in;	9301-0060
61A52	J202	Connector, for error out;	9301-0060
61A52	J203	Connector, for error out ECL;	9301-0060
61A52	J204	Connector, for clock out ECL:	9301-0060
61A52	J205	Connector, for clock out;	9301-0060
61A52	J206	Connector, for clock in;	9301-0060
61A52	J207	Connector, for resync' out;	9301-0060
61A52	Q201	Transistor,	3302-2784
61A52	Q202	Transistor,	3224-5771
61A52	Q203	Transistor,	3302-2784
61A52	Q204	Transistor,	3224-5771
61A52	R201	Resistor, 68Ω ±5% 1/8W composition	0012-2680
61A52	R202	Resistor, 390Ω ±5% 1/8W composition	0012-3390
61A52	R203	Resistor, 100Ω ±5% 1/8W composition	0012-3100
61A52	R204	Reisstor, 270Ω ±5% 1/8W composition	0012-3270
61A52	R205	Resistor, 22Ω ±5% 1/8W composition	0012-2220
61A52	R206	Resistor, 18Ω ±5% 1/8W composition	0012-2180
61A52	R208	Resistor, 150Ω ±5% 1/8W composition	0012-3150
61A52	R210	Resistor, 240Ω ±5% 1/8W composition	0012-3240
61A52	R211 thru R217	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A52	R218	Resistor, 20kΩ ±5% 1/8W composition	0012-5200
61A52	R219	Resistor, 30kΩ ±5% 1/8W composition	0012-5300
61A52	R220	Resistor, 150Ω ±5% 1/8W composition	0012-3150
61A52	R221	Resistor, 150Ω ±5% 1/8W composition	0012-3150
61A52	R222	Resistor, 68Ω ±5% 1/8W composition	0012-2680
61A52	R223	Resistor, 390Ω ±5% 1/8W composition	0012-3390
61A52	R224	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A52	R225	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A52	R226	Resistor, 51Ω ±5% 1/8W composition	0012-2510
61A52	R227	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A52	R228	Resistor, 470Ω ±5% 1/8W composition	0012-3470
61A52	R229	Resistor, 470Ω ±5% 1/8W composition	0012-3470
61A52	R230	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A52	R231	Resistor, 1.2kΩ ±5% 1/8W composition	0012-4120
61A52	R232	Resistor, 2kΩ ±5% 1/8W composition	0012-4200
61A52	R233 thru R236	Resistor, 470Ω ±5% 1/8W composition	0012-3470

Ref Des		Description	Tau-Tron No.
61A52	R237	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A52	R238	Resistor, 1.2kΩ ±5% 1/8W composition	0012-4120
61A52	R239	Resistor, 2kΩ ±5% 1/8W composition	0012-4200
61A52	R240	Resistor, 1.2kΩ ±5% 1/8W composition	0012-4120
61A52	R241	Resistor, 2kΩ ±5% 1/8W composition	0012-4200
61A52	R242	Resistor, 100Ω ±5% 1/8W composition	0012-3100
61A52	R243	Resistor, 270Ω ±5% 1/8W composition	0012-3270
61A52	R244	Resistor, 470Ω ±5% 1/8W composition	0012-3470
61A52	R245	Resistor, 22Ω ±5% 1/8W composition	0012-2220
61A52	R246	Resistor, 150Ω ±5% 1/8W composition	0012-3150
61A52	R248	Resistor, 18Ω ±5% 1/8W composition	0012-2180
61A52	R249	Resistor, 240Ω ±5% 1/8W composition	0012-3240
61A52	R275	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A52	R291	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A52	R292	Resistor, 1kΩ ±5% 1/8W composition	0012-4100
61A52	R501 thru R528	Resistor, 470Ω ±5% 1/8W composition	0012-3470
61A52	UB1	Integrated circuit, MC10102	4012-10102
61A52	UB2	Integrated circuit, MC10102	4012-10102
61A52	UB3	Integrated circuit, MC10131	4012-10131
61A52	UB4	Integrated circuit, MC10132	4012-10131
61A52	UB5	Integrated circuit, MC10102	4012-10102
61A52	UC2	Integrated circuit, SN74H52	4012-74H52
61A52	UC3	Integrated circuit, MC10131	4012-10131
61A52	UC4	Integrated circuit, MC10131	4012-10131
61A52	UC5	Integrated circuit, MC10125	4012-10125
61A52	UD1	Integrated circuit, SN74H01	4012-74H01
61A52	UD2	Integrated circuit, SN7400	4012-7400
61A52	UD3	Integrated circuit, SN7490	4012-7490
61A52	UD4	Integrated circuit, SN7490	4012-7490
61A52	UD5	Integrated circuit, SN7490	4012-7490
61A52	UE1	Integrated circuit, SN74H01	4012-74H01
61A52	UE3	Integrated circuit, SN7490	4012-7490
61A52	UE4	Integrated circuit, SN7490	4012-7490
61A52	UE5	Integrated circuit, SN74196	4012-74196
61A52	UF1	Integrated circuit, SN74LS74	4012-74LS74
61A52	UF2	Integrated circuit, SN74H52	4012-74H52
61A52	UF3	Integrated circuit, SN74123	4012-74123
61A52	UF4	Integrated circuit, SN7474A	4012-7474A
61A52	UF5	Integrated circuit, SN7401	4012-7401

Ref Des		Description	Tau-Tron No.
61A53		**COUNTER**	
61A53	C301 thru 61A53 C304	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A53	C305	Capacitor, 20% 25V, 10μF miniature tantalum.....	1064-4210
61A53	C306	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A53	C307	Capacitor, 10% 200V, 47pF ceramic.....	1013-8247
61A53	C308	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A53	C309	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A53	C310	Capacitor, 20% 25V, 10μF miniature tantalum.....	1064-4210
61A53	C311	Capacitor, 10% 200V, 47pF ceramic.....	1013-8247
61A53	C312	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A53	C317	Capacitor, 20% 25V, 47μF miniature tantalum.....	1064-0847
61A53	C319	Capacitor, 20% 10V, 33μF miniature tantalum.....	1064-1233
61A53	C320	Capacitor, 20% 10V, 33μF miniature tantalum.....	1064-1233
61A53	C381	Capacitor, 20% 25V, 10μF miniature tantalum.....	1064-4210
61A53	C382	Capacitor, 20% 200V, 47μF miniature tantalum.....	1064-0847
61A53	C383	Capacitor, 20% 200V, 1000pF cermaic.....	1014-8410
61A53	C384	Capacitor, 20% 200V, 4.7μF ceramic.....	1014-8447
61A53	C501 thru 61A53 C560	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A53	D301	Diode,.....	2112-4148
61A53	J301	Connector, for sync out.....	9301-0060
61A53	J302	Connector, for TM out;	9301-0060
61A53	J303	Connector, for gate in;.....	9301-0060
61A53	J304	Connector, for clk in;	9301-0060
61A53	J305	Connector, for sync in;.....	9301-0060
61A53	J306	Connector, for err in;.....	9301-0060
61A53	Q301	Transistor,.....	3302-2784
61A53	Q302	Transistor,.....	3224-5771
61A53	Q303	Transistor,.....	3302-2784
61A53	Q304	Transistor,.....	3224-5771
61A53	R301	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A53	R302	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
61A53	R303	Resistor, 100Ω ±5% 1/8W composition.....	0012-3100
61A53	R304	Resistor, 270Ω ±5% 1/8W composition.....	0012-3270
61A53	R305	Resistor, 2kΩ ±5% 1/8W composition.....	0012-4200
61A53	R306	Resistor, 100Ω ±5% 1/8W composition.....	0012-3100
61A53	R307	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A53	R308	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
61A53	R309	Resistor, 100Ω ±5% 1/8W composition.....	0012-3100
61A53	R310	Resistor, 270Ω ±5% 1/8W composition.....	0012-3270

Ref Des		Description	Tau-Tron No.
61A53	R311	Resistor, 2kΩ ±5% 1/8W composition.....	0012-4200
61A53	R312	Resistor, 100Ω ±5% 1/8W composition.....	0012-3100
61A53	R314	Resistor, 180Ω ±5% 1/8W composition.....	0012-3180
61A53	R315	Resistor, 240Ω ±5% 1/8W composition.....	0012-3240
61A53	R316	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A53	R317	Resistor, 39Ω ±5% 1/8W composition.....	0012-2390
61A53	R318	Resistor, 33Ω ±5% 1/8W composition.....	0012-2330
61A53	R319	Resistor, 240Ω ±5% 1/8W composition.....	0012-3240
61A53	R320	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A53	R321	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
61A53	R322	Resistor, 100Ω ±5% 1/8W composition.....	0012-3100
61A53	R323	Resistor, 270Ω ±5% 1/8W composition.....	0012-3270
61A53	R324	Resistor, 430Ω ±5% 1/8W composition.....	0012-3430
61A53	R325	Resistor, 430Ω ±5% 1/8W composition.....	0012-3430
61A53	R326	Resistor, 200Ω ±5% 1/8W composition.....	0012-3200
61A53	R327	Resistor, 200Ω ±5% 1/8W composition.....	0012-3200
61A53	R332	Resistor, 180Ω ±5% 1/8W composition.....	0012-3180
61A53	R333	Resistor, 240Ω ±5% 1/8W composition.....	0012-3240
61A53	R334	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A53	R335	Resistor, 39Ω ±5% 1/8W composition.....	0012-2390
61A53	R336	Resistor, 33Ω ±5% 1/8W composition.....	0012-2330
61A53	R337	Resistor, 240Ω ±5% 1/8W composition.....	0012-3240
61A53	R338 thru R342	Resistor, 430Ω ±5% 1/8W composition.....	0012-3430
61A53	R343	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
61A53	R344 thru R347	Resistor, 430Ω ±5% 1/8W composition.....	0012-3430
61A53	R348	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
61A53	R349	Resistor, 68Ω ±5% 1/8W composition.....	0012-2680
61A53	R350	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A53	R356	Resistor, 51Ω ±5% 1/8W composition.....	0012-5510
61A53	R358	Resistor, 2kΩ ±5% 1/8W composition.....	0012-4200
61A53	R501 thru R533	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A53	UA2	Integrated circuit,.....	4012-10115
61A53	UB2	Integrated circuit,.....	4012-10102
61A53	UB3	Integrated circuit,.....	4012-10231
61A53	UB4	Integrated circuit,.....	4012-10102
61A53	UB5	Integrated circuit,.....	4012-10109

Ref Des		Description	Tau-Tron No.
61A53	UB6	Integrated circuit,.....	4012-10138
61A53	UC1	Integrated circuit,.....	4012-10138
61A53	UC2	Integrated circuit,.....	4012-10109
61A53	UC3	Integrated circuit,.....	4012-10124
61A53	UC4	Integrated circuit,.....	4012-74H20
61A53	UC5	Integrated circuit,.....	4012-74LS01
61A53	UC6	Integrated circuit,.....	4012-74LS01
61A53	UD1	Integrated circuit,.....	4012-10125
61A53	UD2	Integrated circuit,.....	4012-7432
61A53	UD3	Integrated circuit,.....	4012-10125
61A53	UD4	Integrated circuit,.....	4012-74LS196
61A53	UD5	Integrated circuit,.....	4012-7490
61A53	UD6	Integratee circuit,.....	4012-7490
61A53	UE1	Integrated circuit,.....	4012-74123
61A53	UE2	Integrated circuit,.....	4012-7408
61A53	UE3	Integrated circuit,.....	4012-7400
61A53	UE4	Integrated circuit,.....	4012-7490
61A53	UE5	Integrated circuit,.....	4012-7490
61A53	UE6	Integrated circuit,.....	4012-7490
61A53	UF1	Integrated circuit,.....	4012-7432
61A53	UF2	Integrated circuit,.....	4012-7400
61A53	UF3	Integrated circuit,.....	4012-7404
61A53	UF4	Integrated circuit,.....	4012-7490
61A53	UF5	Integrated circuit,.....	4012-7490
61A53	UF6	Integrated circuit,.....	4012-7490
61A54		**INTERFACE**	9601-0242
61A54	C1	Capacitor, 20% 20V, 4.7μF miniature tantalum.....	1064-3747
61A54	C2	Capacitor, 20% 6V, 47μF 10V miniature tantalum.....	1064-0847
61A54	C3 thru C11	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A54	C12	Capacitor, 10% 200V, 47pF ceramic.....	1013-8247
61A54	C13	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A54	C14	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A54	C15	Capacitor, 20% 10V, 33μF miniature tantalum.....	1064-1233
61A54	C16	Capacitor, 20% 10V, 33μF miniature tantalum.....	1064-1233
61A54	C17 thru C38	Capacitor, 20% 50V, .01μF chip bypass.....	1084-4710
61A54	D1	Diode.....	2112-4710
61A54	D2	Diode.....	2112-4148

Ref Des		Description	Tau-Tron No.
61A54	DL1	Delay line, 18ns 144 in	
61A54	DL2	Delay line, 38ns 304 in	
61A54	DL3	Delay line, 6ns 48 in	
61A54	DL4	Delay line, 18ns 144 in	
61A54	DL5	Delay line, 13ns 104 in	
61A54	Q1	Transistor, ...	3224-5771
61A54	Q2	Transistor, ...	3224-5771
61A54	Q3	Transistor, ...	3302-2784
61A54	Q4	Transistor, ...	3224-5771
61A54	R1	Resistor, 130Ω ±5% 1/8W composition.....	0012-3130
61A54	R2	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R3	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
61A54	R4	Resistor, 100Ω ±5% 1/8W composition.....	0012-3100
61A54	R5	Resistor, 100Ω ±5% 1/8W composition.....	0012-3100
61A54	R6	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
61A54	R7	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
61A54	R8	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R9	Resistor, 75Ω ±5% 1/8W composition.....	0012-2750
61A54	R10	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A54	R11	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R12	Resistor, 75Ω ±5% 1/8W composition.....	0012-2750
61A54	R13	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A54	R14	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R15	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R16	Resistor, 75Ω ±5% 1/8W composition.....	0012-2750
61A54	R17	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A54	R18	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R19	Resistor, 75Ω ±5% 1/8W composition.....	0012-2750
61A54	R20	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A54	R21	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R22	Resistor, 75Ω ±5% 1/8W composition.....	0012-2750
61A54	R23	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A54	R24	Resistor, 75Ω ±5% 1/8W composition.....	0012-2750
61A54	R25	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A54	R26 thru R29	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R30	Resistor, 240Ω ±5% 1/8W composition.....	0012-3240
61A54	R31	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
61A54	R32 thru R35	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470

Ref Des		Description	Tau-Tron No.
61A54	R36	Resistor, 75Ω ±5% 1/8W composition.....	0012-2750
61A54	R37	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A54	R38	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R39	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R40	Resistor, 75Ω ±5% 1/8W composition.....	0012-2750
61A54	R41	Resistor, 390Ω ±5% 1/8W composition.....	0012-3390
61A54	R42	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R43	Resistor, 150Ω ±5% 1/8W composition.....	0012-3150
61A54	R44	Resistor, 39Ω ±5% 1/8W composition.....	0012-2390
61A54	R45	Resistor, 270Ω ±5% 1/8W composition.....	0012-3270
61A54	R46	Resistor, 470Ω ±5% 1/8W composition.....	0012-3470
61A54	R47	Resistor, 39Ω ±5% 1/8W composition.....	0012-2390
61A54	R48	Resistor, 240Ω ±5% 1/8W composition.....	0012-3240
61A54	R49	Resistor, 9.1kΩ ±5% 1/8W composition.....	0012-4910
61A54	R50	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
61A54	R51	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
61A54	R52	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
61A54	R53	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
61A54	R54	Resistor, 51Ω ±5% 1/8W composition.....	0012-2510
61A54	R55	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
61A54	R56	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
61A54	R57	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
61A54	R58	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
61A54	R59	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
61A54	R60	Resistor, 9.1kΩ ±5% 1/8W composition.....	0012-4910
61A54	R61	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
61A54	R62	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
61A54	R63	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
61A54	R64	Resistor, 1kΩ ±5% 1/8W composition.....	0012-4100
61A54	R91	Resistor, 3kΩ ±5% 1/8W composition.....	0012-4300
61A54	UA2	Integrated circuit,.....	4012-7474
61A54	UA3	Integrated circuit,.....	4012-7474
61A54	UB1	Integrated circuit,.....	4012-7400
61A54	UB2	Integrated circuit,.....	4012-74123
61A54	UB3	Integrated circuit,.....	4012-7486
61A54	UB4	Integrated circuit,.....	4012-10131
61A54	UB5	Integrated circuit,.....	4012-10131
61A54	UC1	Integrated circuit,.....	4012-10124
61A54	UC2	Integrated circuit,.....	4012-7410
61A54	UC3	Integrated circuit,.....	4012-7402
61A54	UC4	Integrated circuit,.....	4012-10102
61A54	UC5	Integrated circuit,.....	4012-10107
61A54	UD2	Integrated circuit,.....	4012-7400
61A54	UD3	Integrated circuit,.....	4012-10102
61A54	UD5	Integrated circuit,.....	4012-10101

Diagrams

61.600 **CONTENTS**

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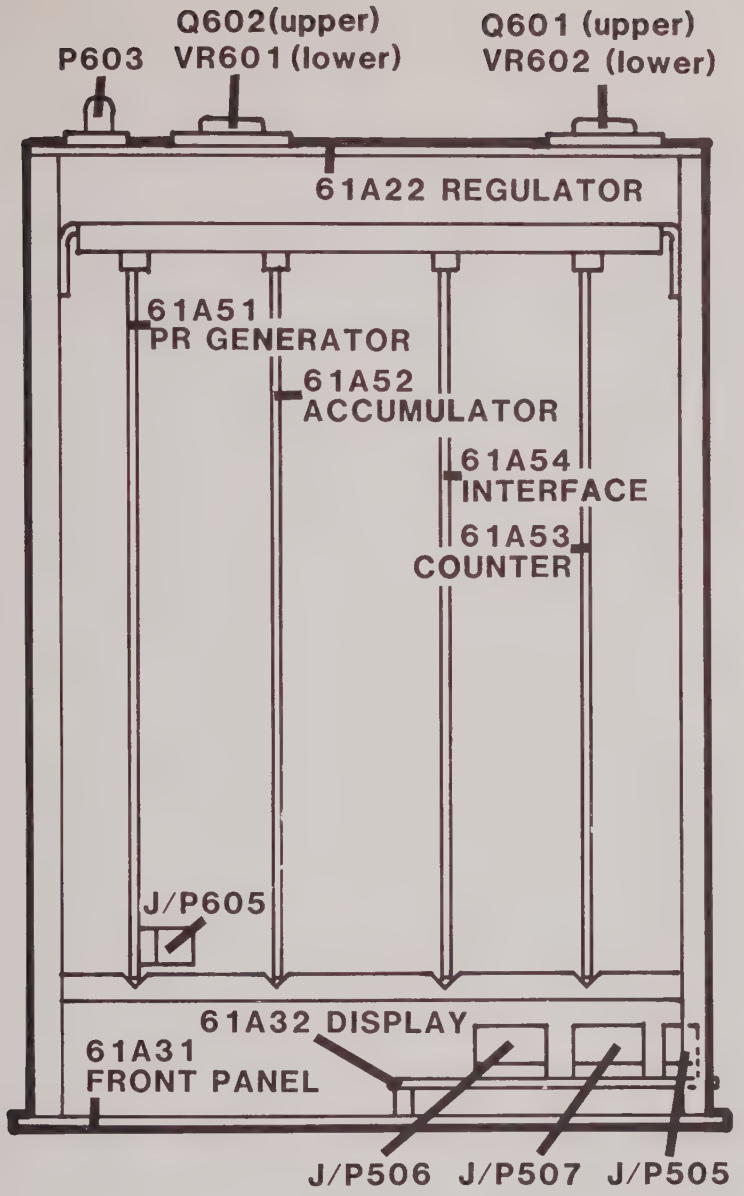
61A21 Rear Panel..... ---
61A22 Regulator..... 61-605
61A31 Front Panel..... 61-607
61A32 Display..... 61-609
61A51 PR Generator..... 61-611
61A52 Accumulator..... 61-615
61A53 Counter..... 61-619
61A54 Interface..... 61-623



PARTS VALUES

Unless noted otherwise:

C in μF
L in μH
R in Ω
* special, see parts list

For full type numbers of ICs and transistors, see parts list

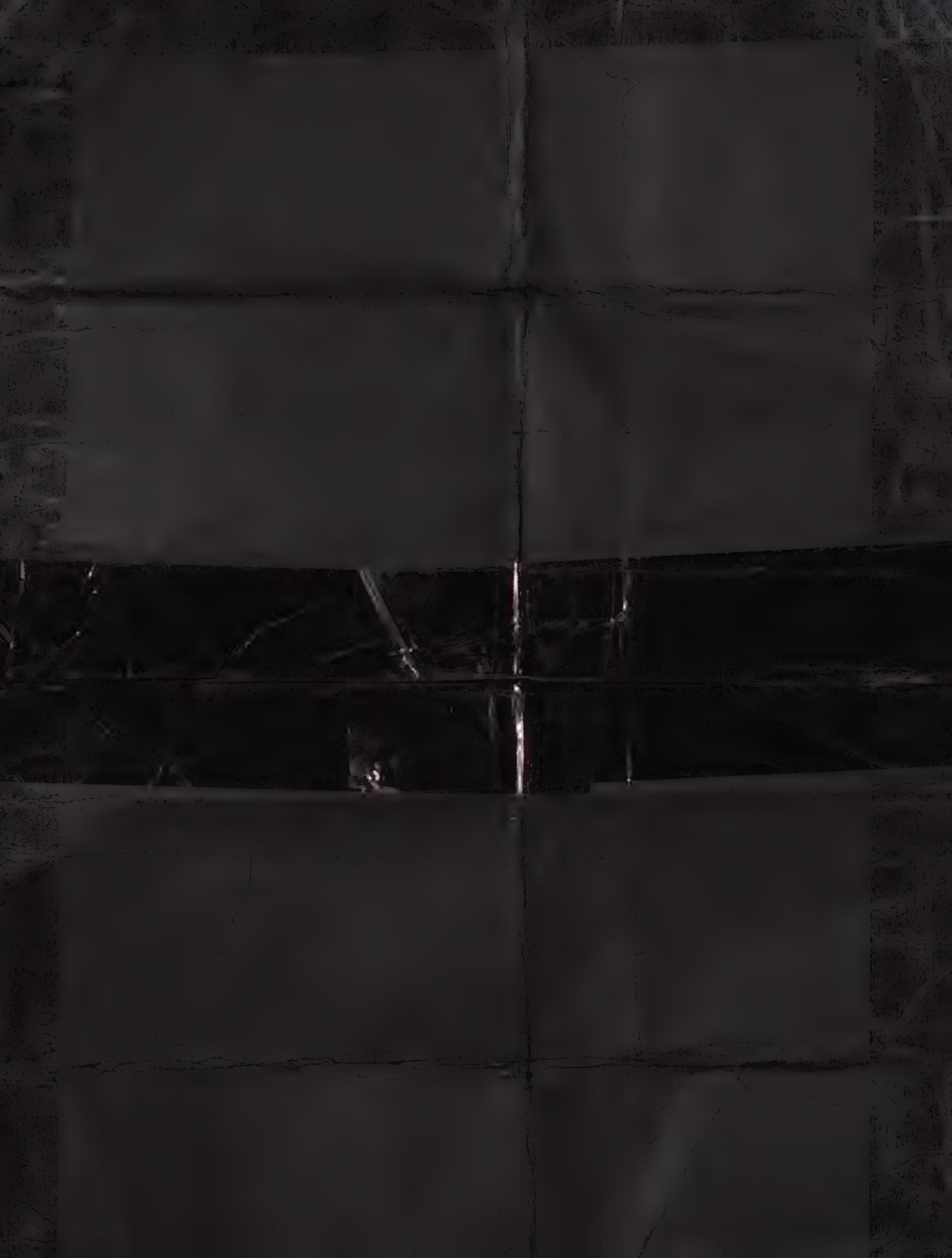
REFERENCE DESIGNATIONS

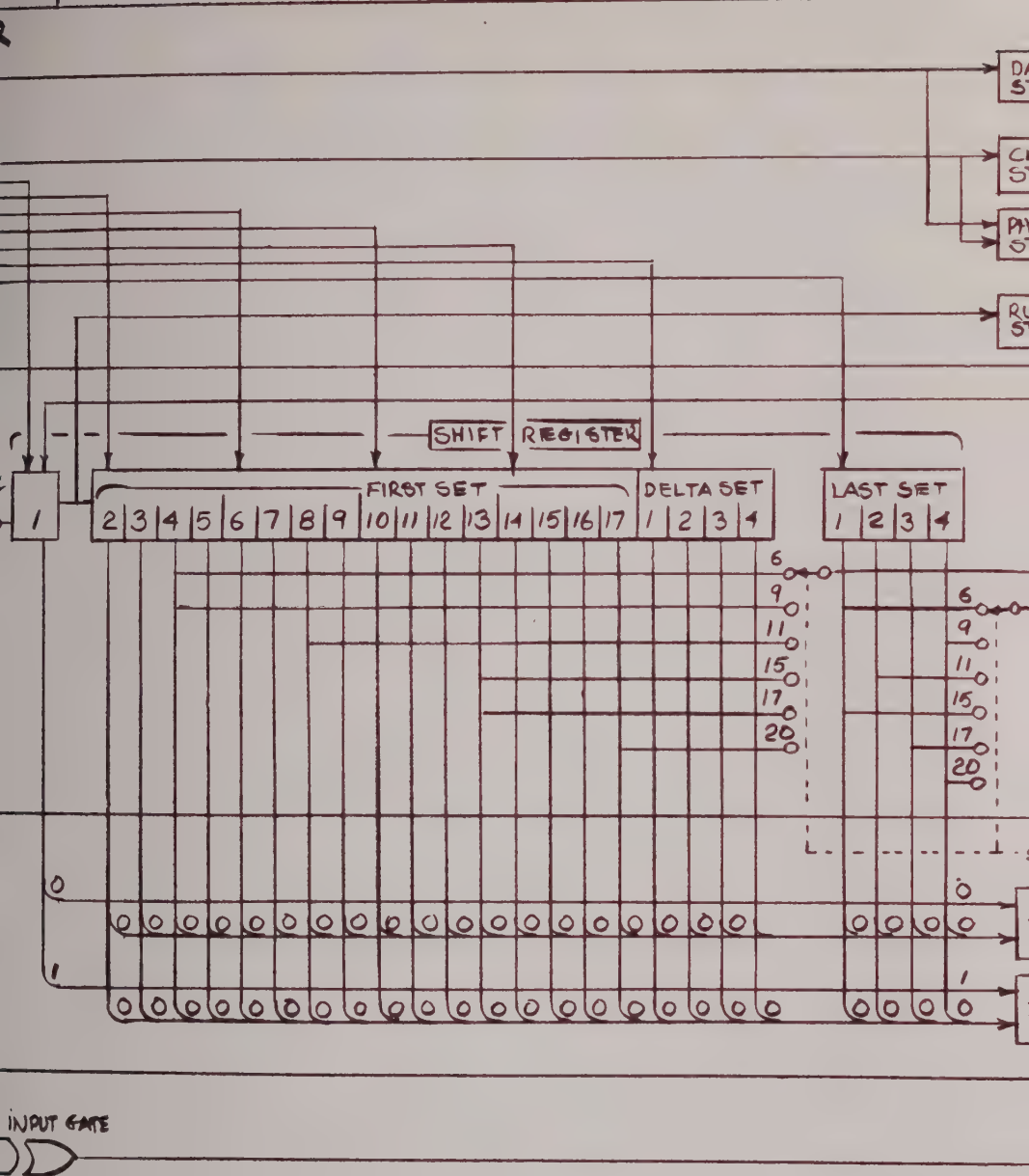
Full reference designations include assembly prefix

SIGNAL ORIGIN

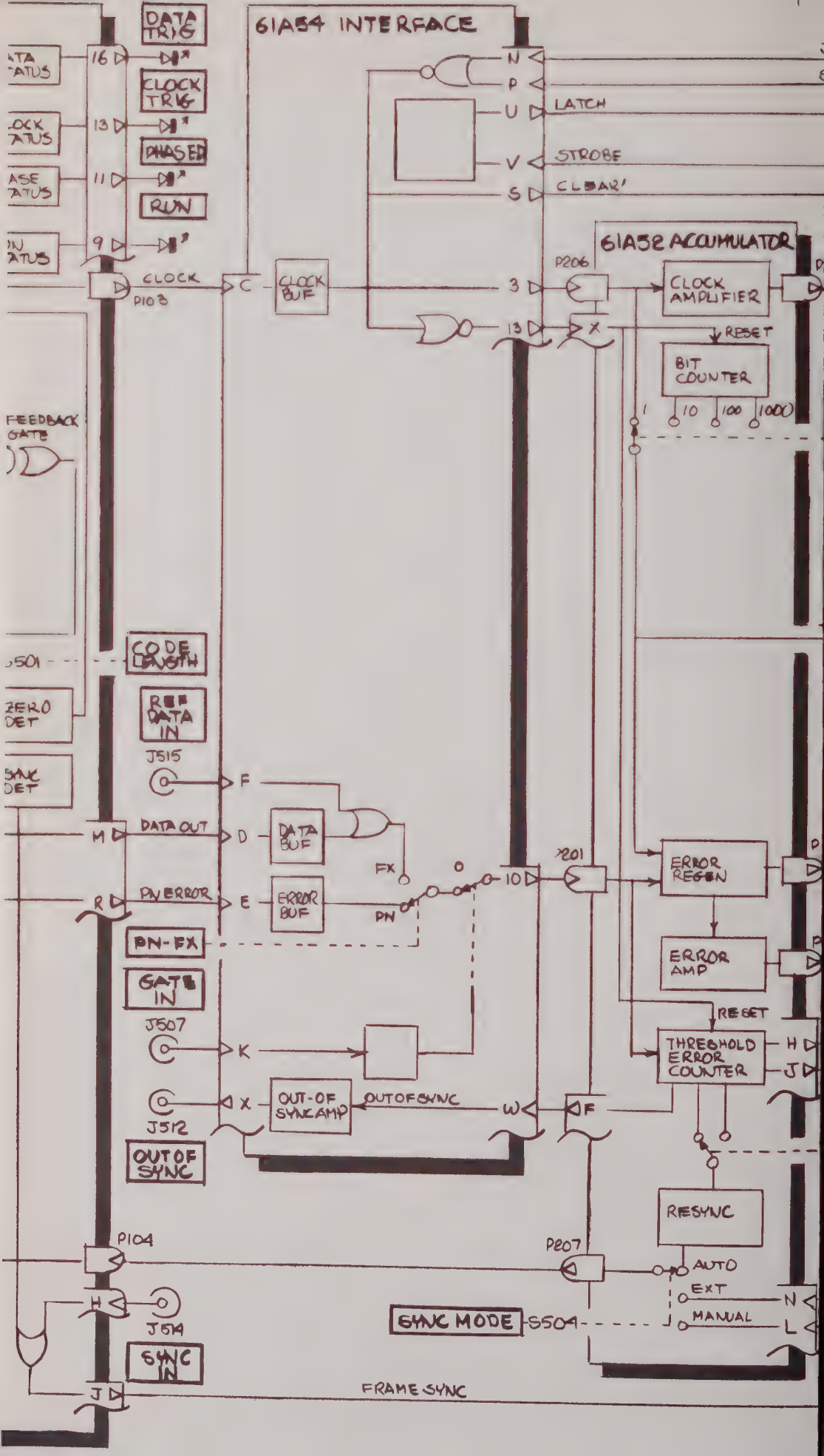
▷— input
—▷ output

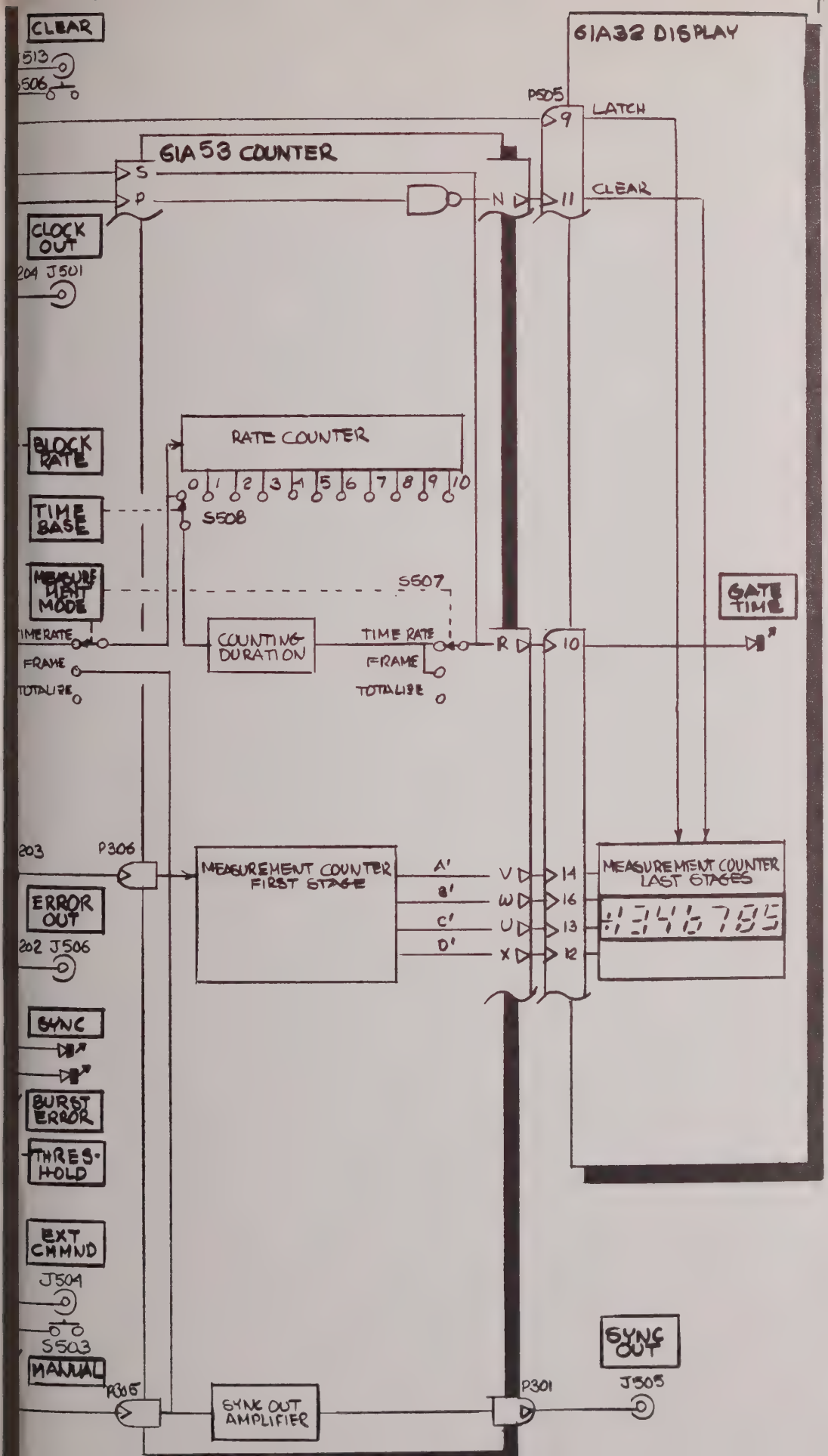
61A51 PR GENERATO
PHASE
R501
B05
CLK IN
J502 P101
DATA IN
J503 P102
CLOCK INPUT
CLOCK PHASE
DATA INPUT
DATA LATCH
CLOCK DIST
NORM



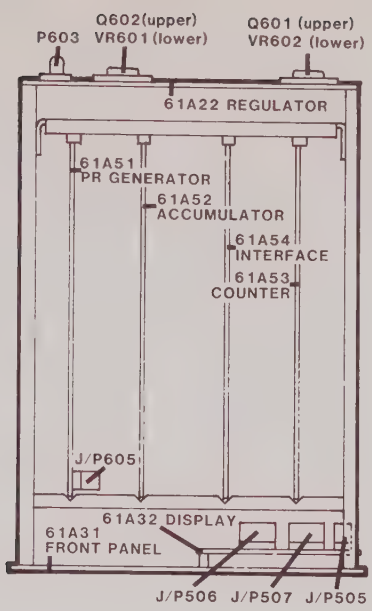

SHIFT REGISTER
FIRST SET
DELTA SET
LAST SET
1
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
1 2 3 4
1 2 3 4
6
9
11
15
17
20
0
1

INPUT GATE


61A54 INTERFACE
61A52 ACCUMULATOR
DATA TRIG
CLOCK TRIG
PHASED
RUN
CLOCK
P103
CLOCK BUF
N
P
U
LATCH
V
STROBE
S
CLEAR'
P206
CLOCK AMPLIFIER
RESET
BIT COUNTER
1
10
100
1000
FEEDBACK GATE
CODE LENGTH
REF DATA IN
J515
ZERO DET
SYNC DET
DATA OUT
DATA BUF
FX
PN ERROR
ERROR BUF
PN
P201
ERROR REGEN
ERROR AMP
PN-FX
GATE IN
J507
THRESHOLD ERROR COUNTER
OUT-OF SYNC AMP
OUT OF SYNC
J512
RESYNC
P104
P207
AUTO
EXT
MANUAL
SYNC MODE
S504
J514
SYNC IN
FRAME SYNC



Form 0155-1081C
TAU-TRON
MB-1A
1of1 **BLOCK**



PARTS VALUES

Unless noted otherwise:

C in μF
L in μH
R in Ω
* special, see parts list

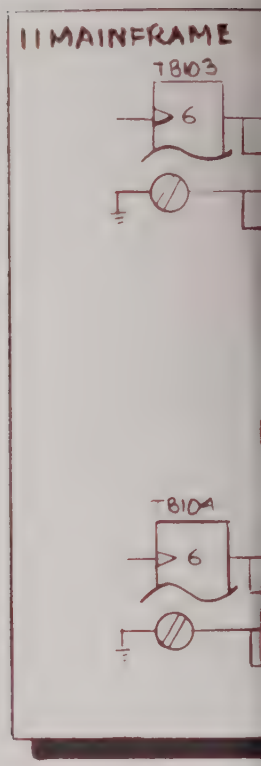
For full type numbers of ICs and transistors, see parts list

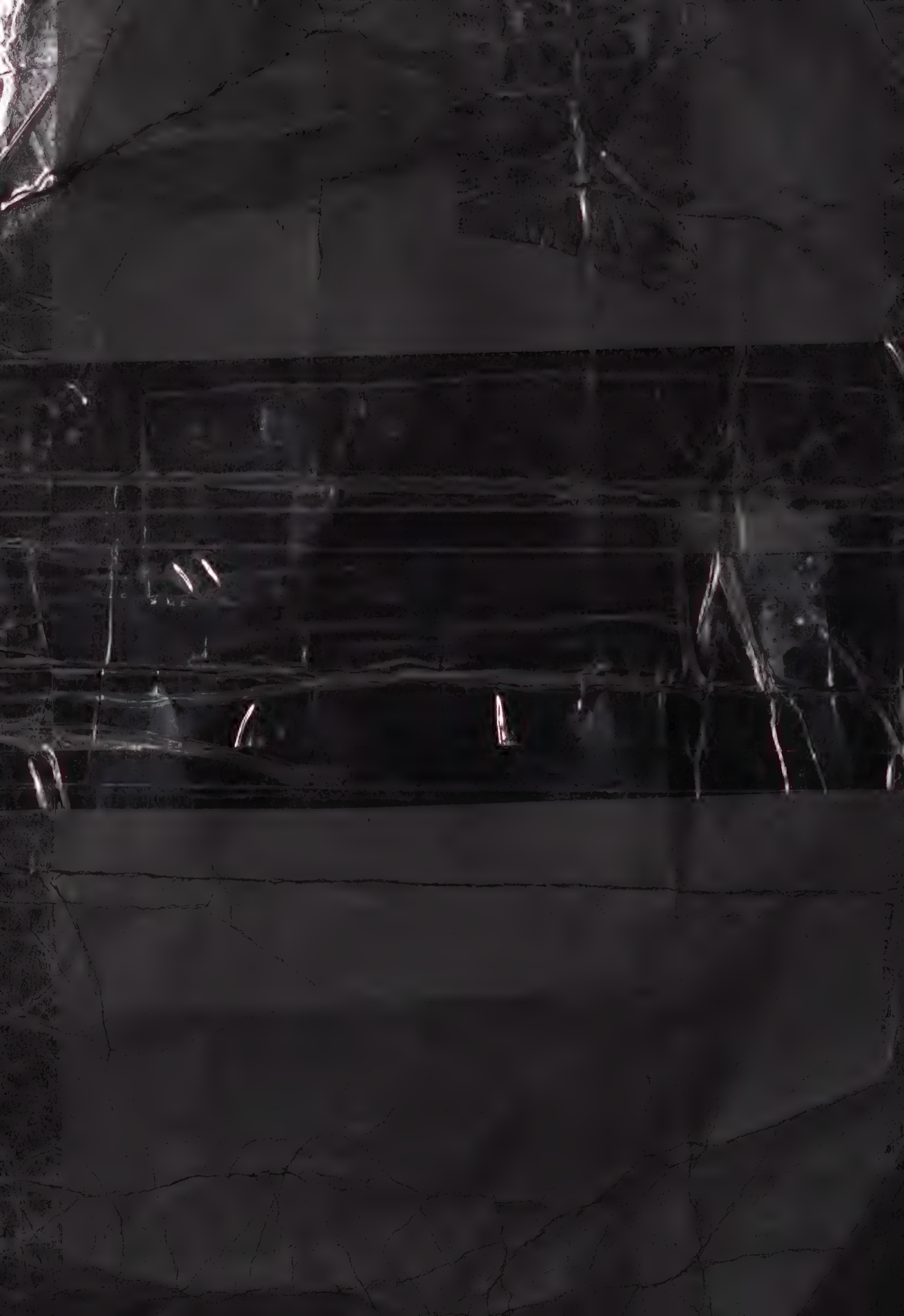
REFERENCE DESIGNATIONS

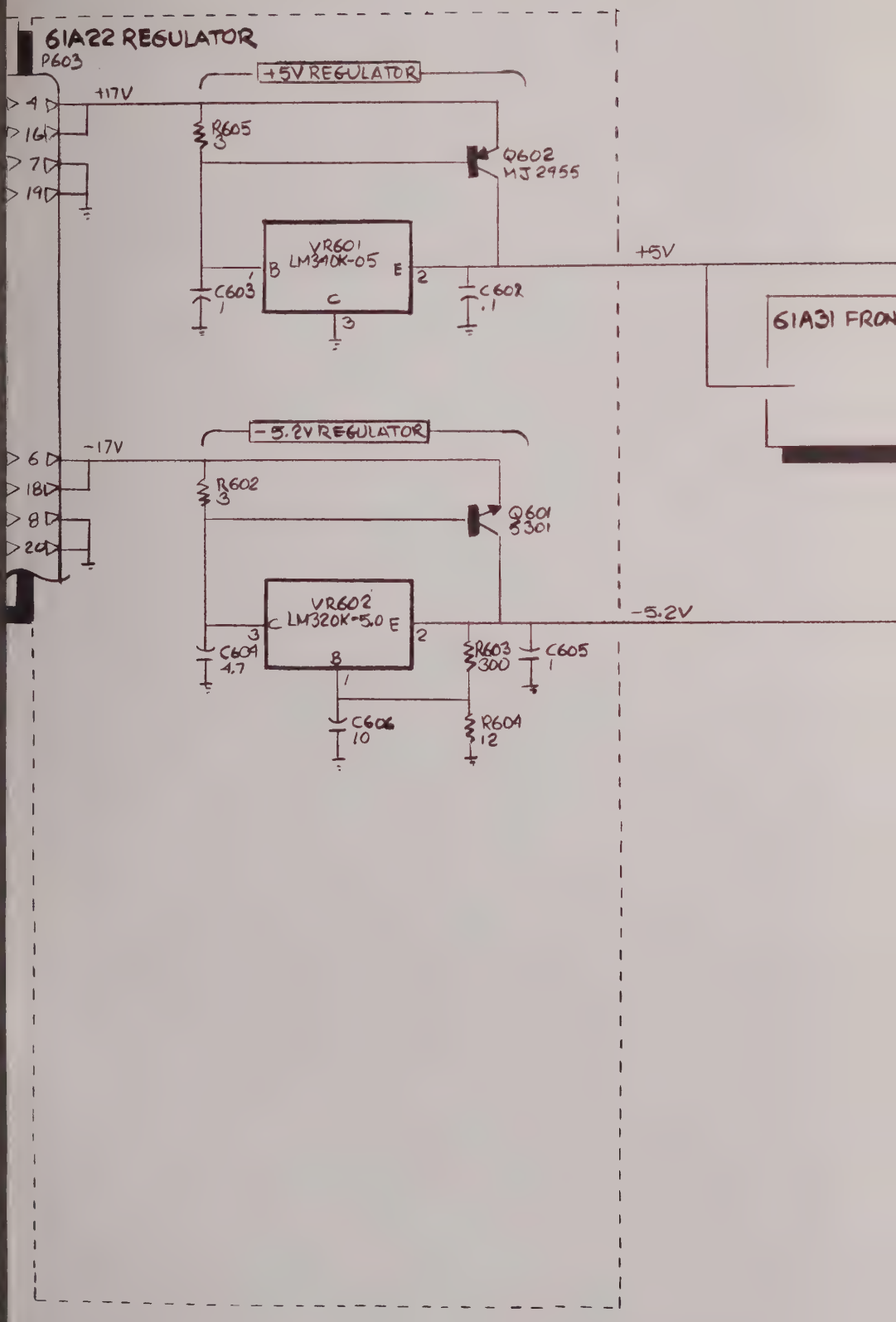
Full reference designations include assembly prefix

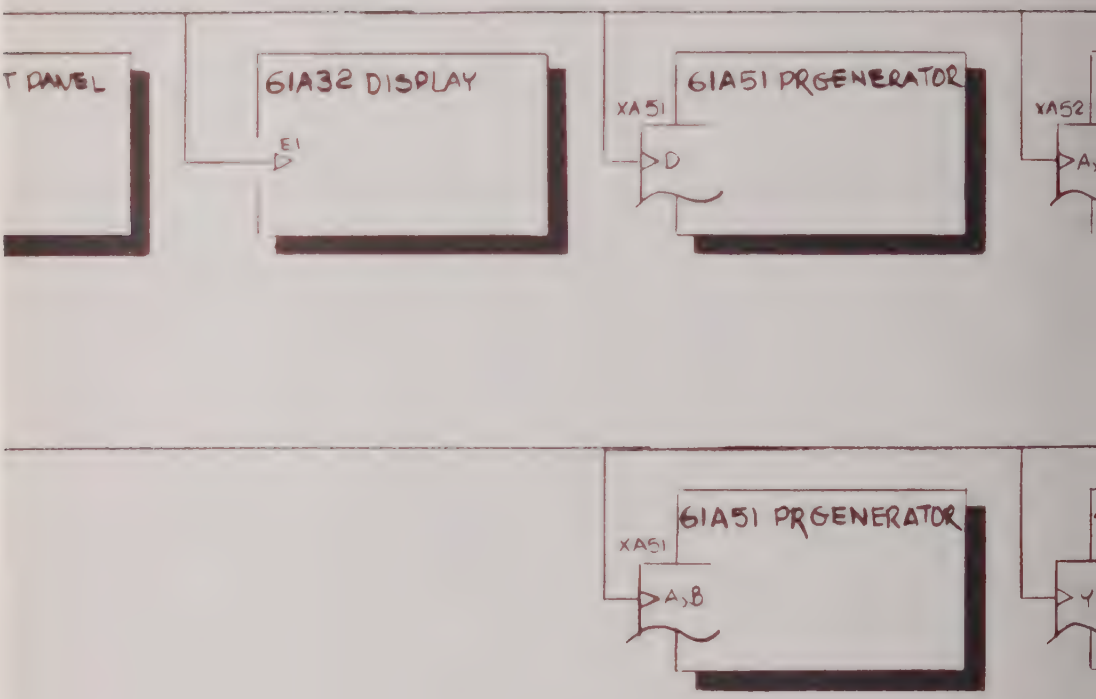
SIGNAL ORIGIN

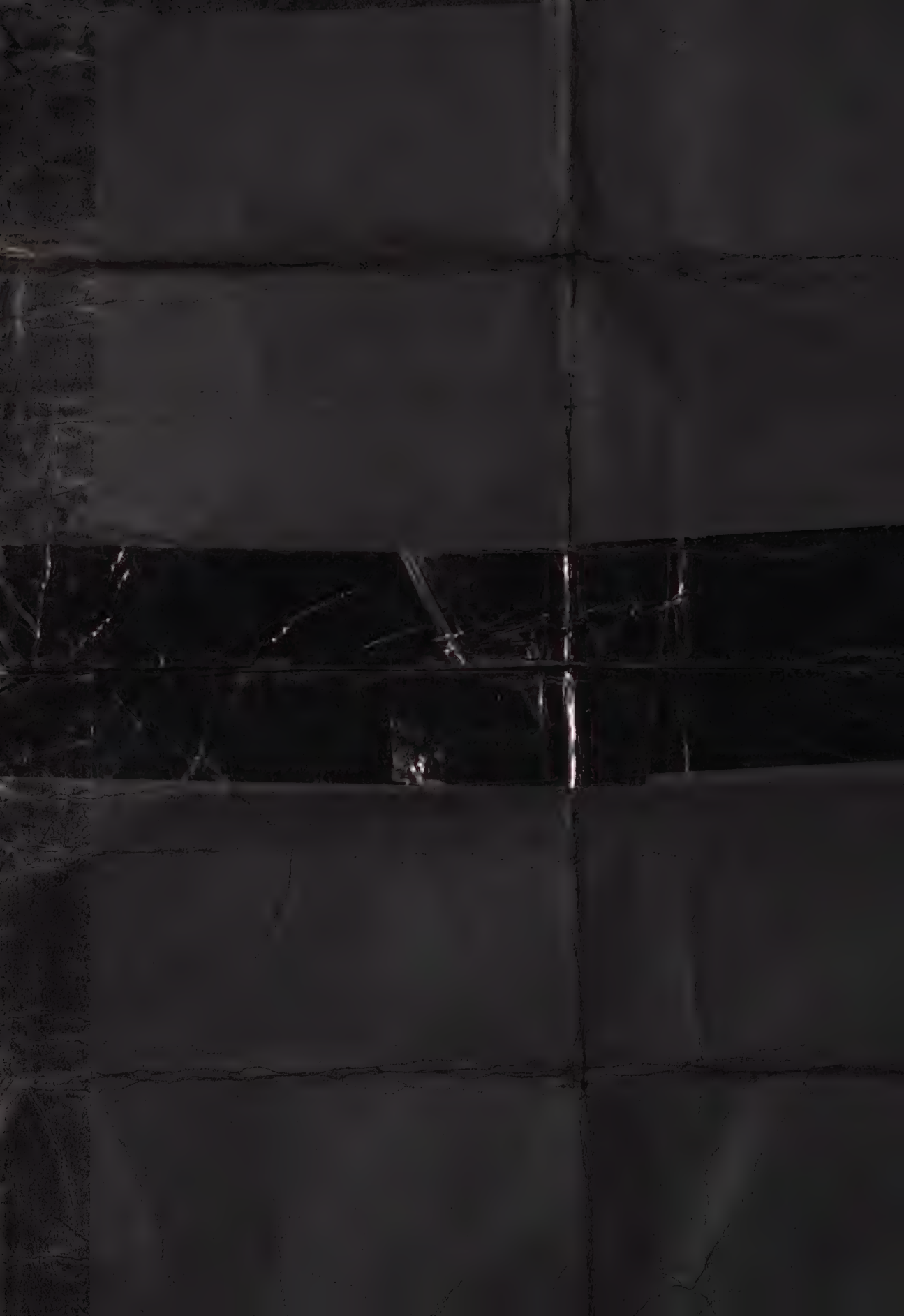
▷— input
—▷ output

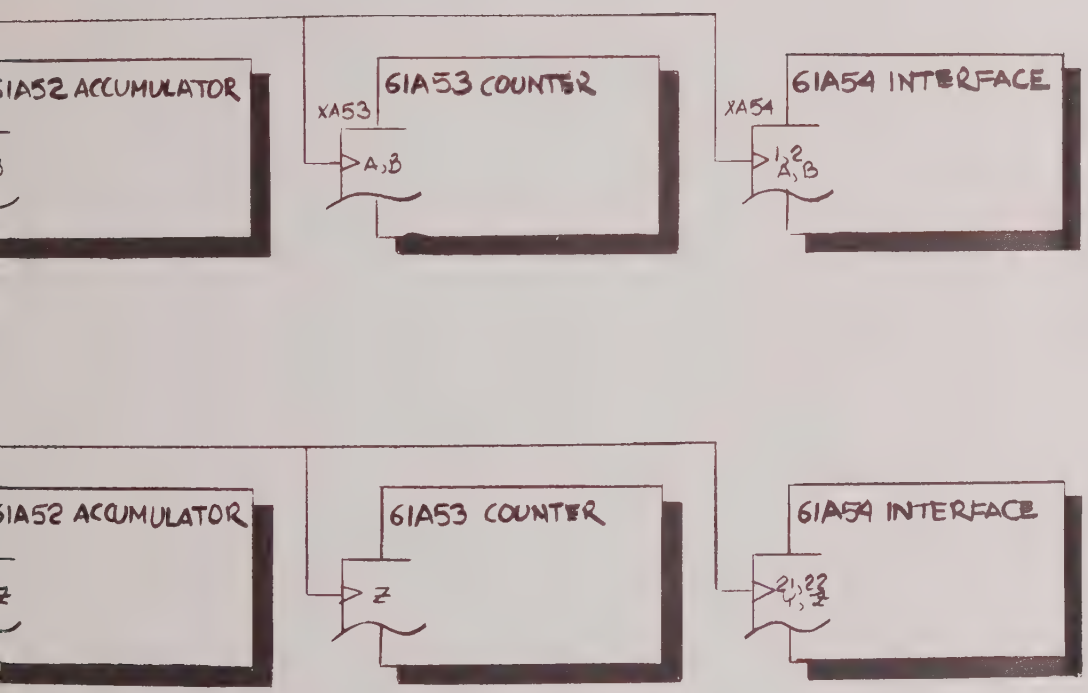

11 MAINFRAME
TB103
6
TB104
6




61A22 REGULATOR
P603
+5V REGULATOR
+17V
4
16
7
19
R605
3
Q602
MJ2955
VR601
LM340K-05
B
E
C
2
3
C603
1
C602
.1
+5V
61A31 FRON
-5.2V REGULATOR
-17V
6
18
8
20
R602
3
Q601
3301
VR602
LM320K-5.0
C
E
B
3
2
1
C604
4.7
R603
300
C605
1
C606
10
R604
12
-5.2V


T PANEL
61A32 DISPLAY
E1
XA51
61A51 PRGENERATOR
D
XA52
61A51 PRGENERATOR
XA51
A,B



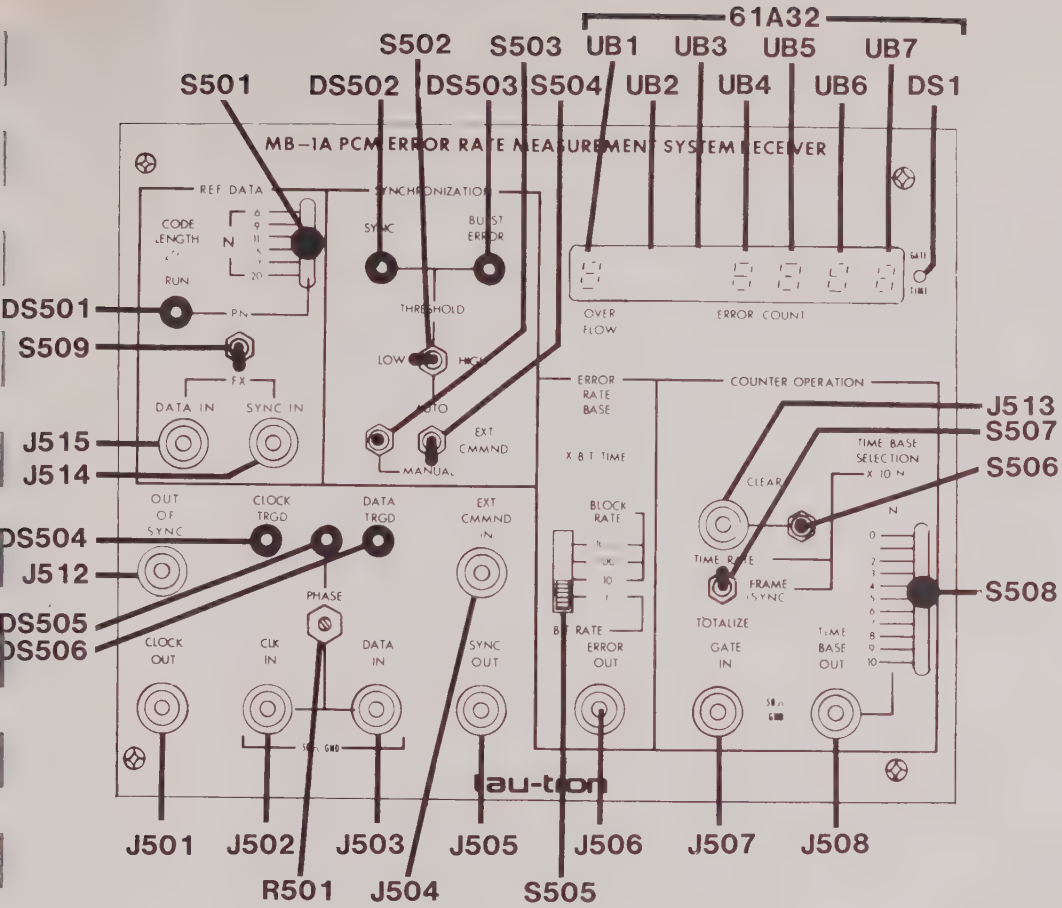


TAJ-53385

Form 0155-1081C
TAU-TRON
MB-1A

1 of 1 **61A22**
REGULATOR

61-605



PARTS

Unless n

C in μF

L in μH

R in Ω

* specia

For full

ICs and

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REFERE

Full refe

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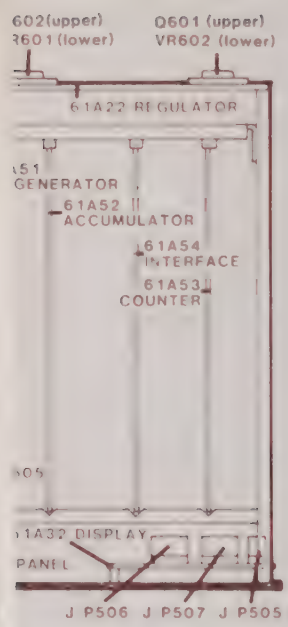
SIGNAL

inpu

outp



VALUES

oted otherwise

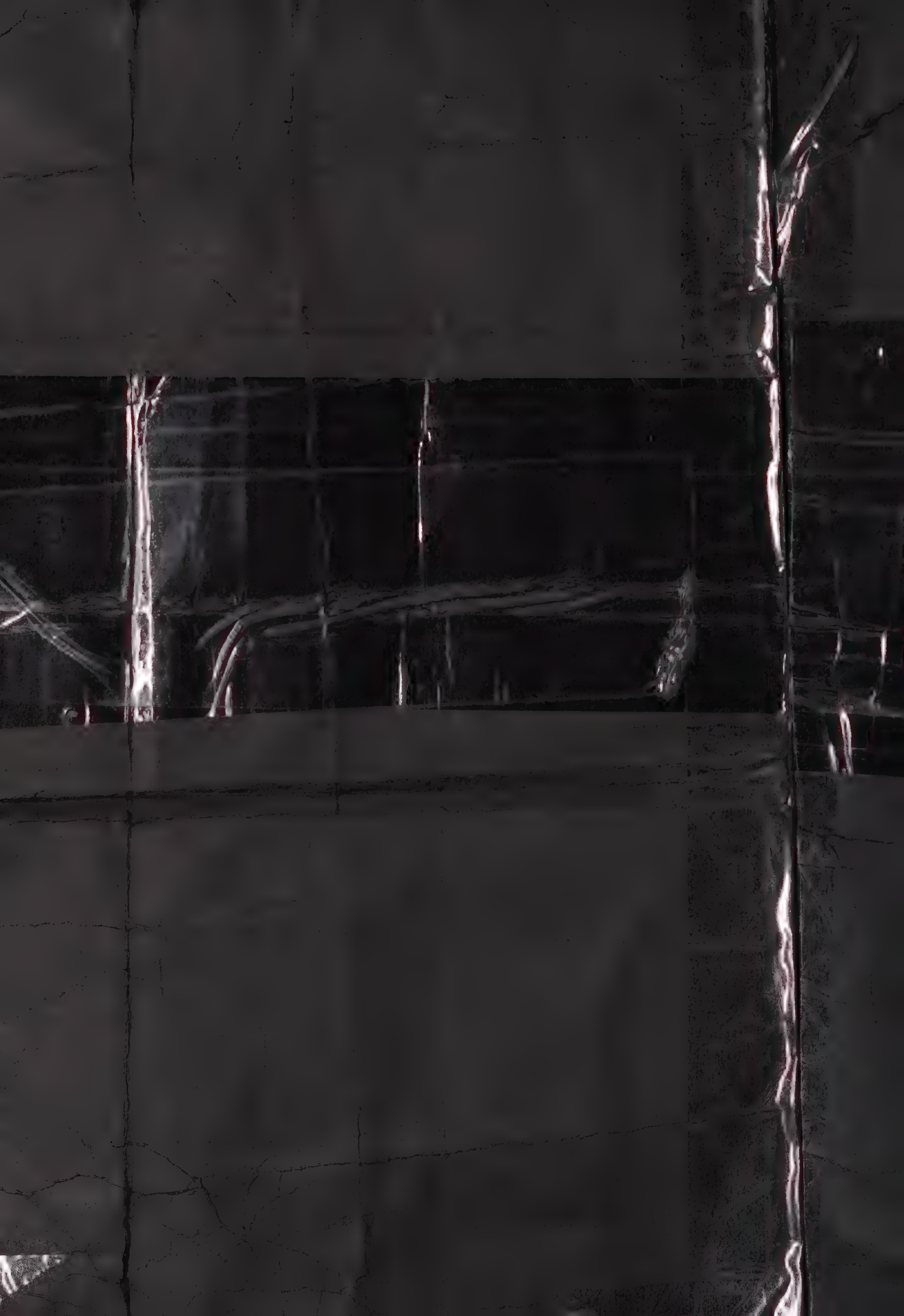
l, see parts list
ype numbers of
transistors.
s list

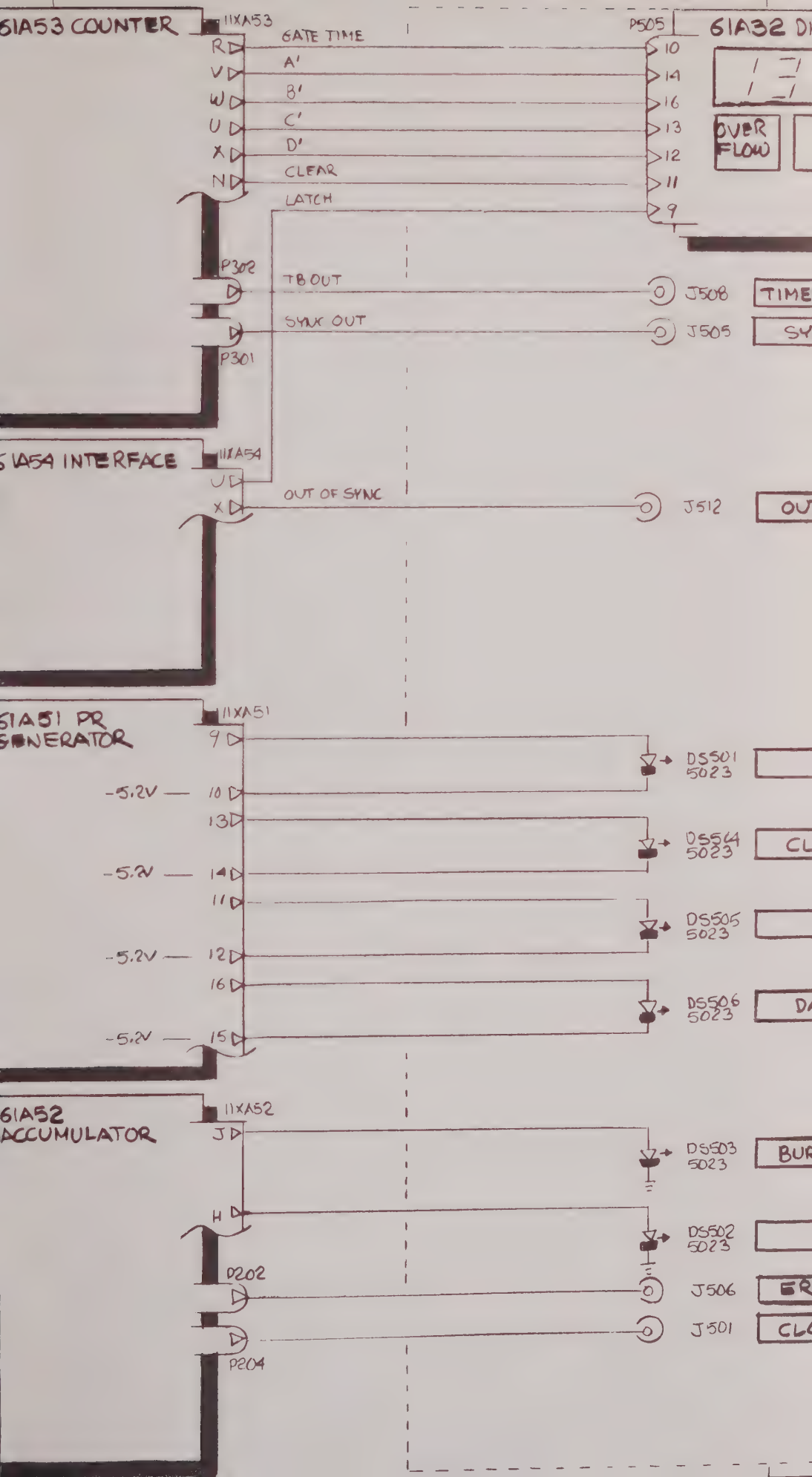
NCE DESIGNATIONS

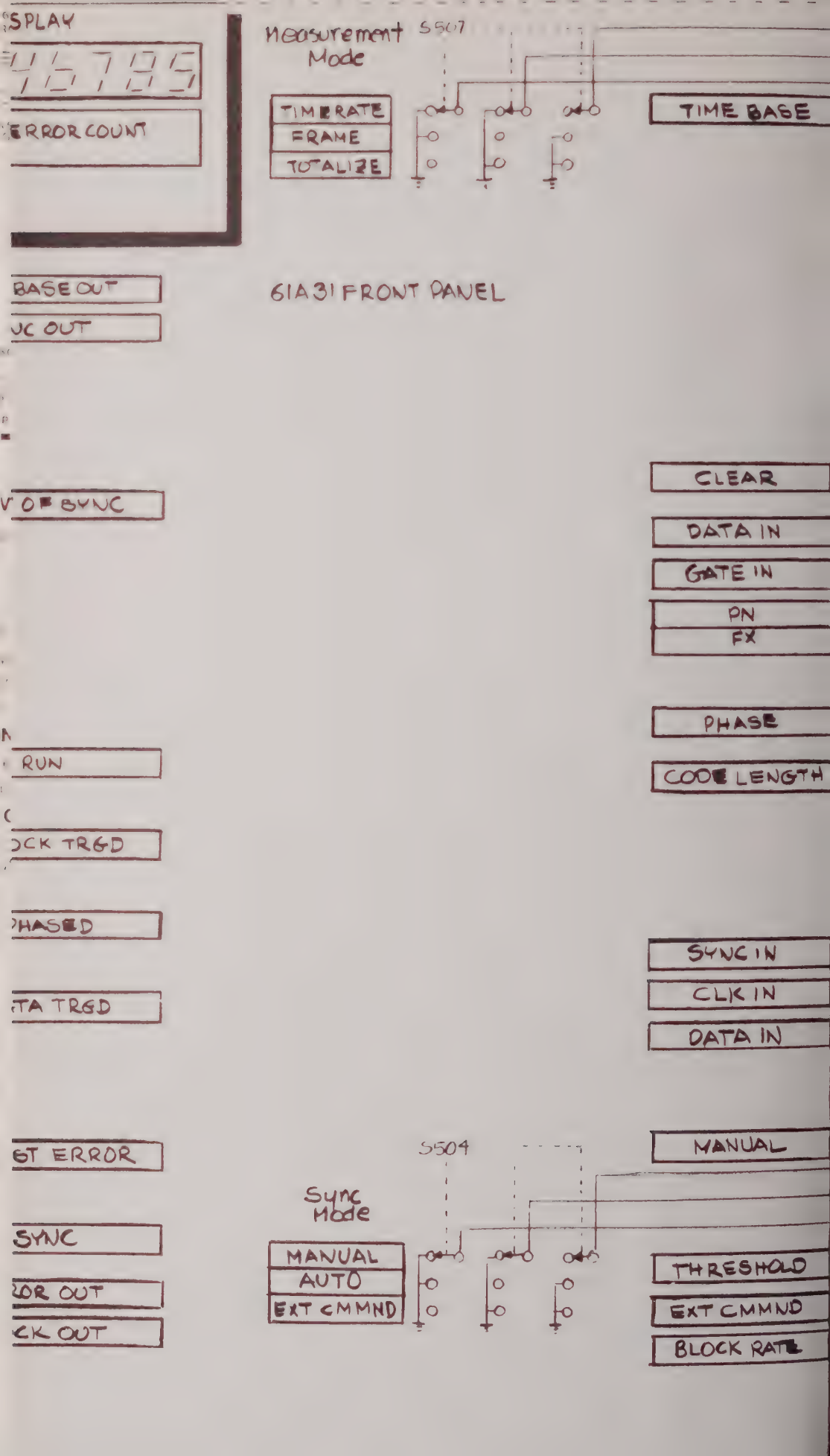
ence designations
ssembly prefix

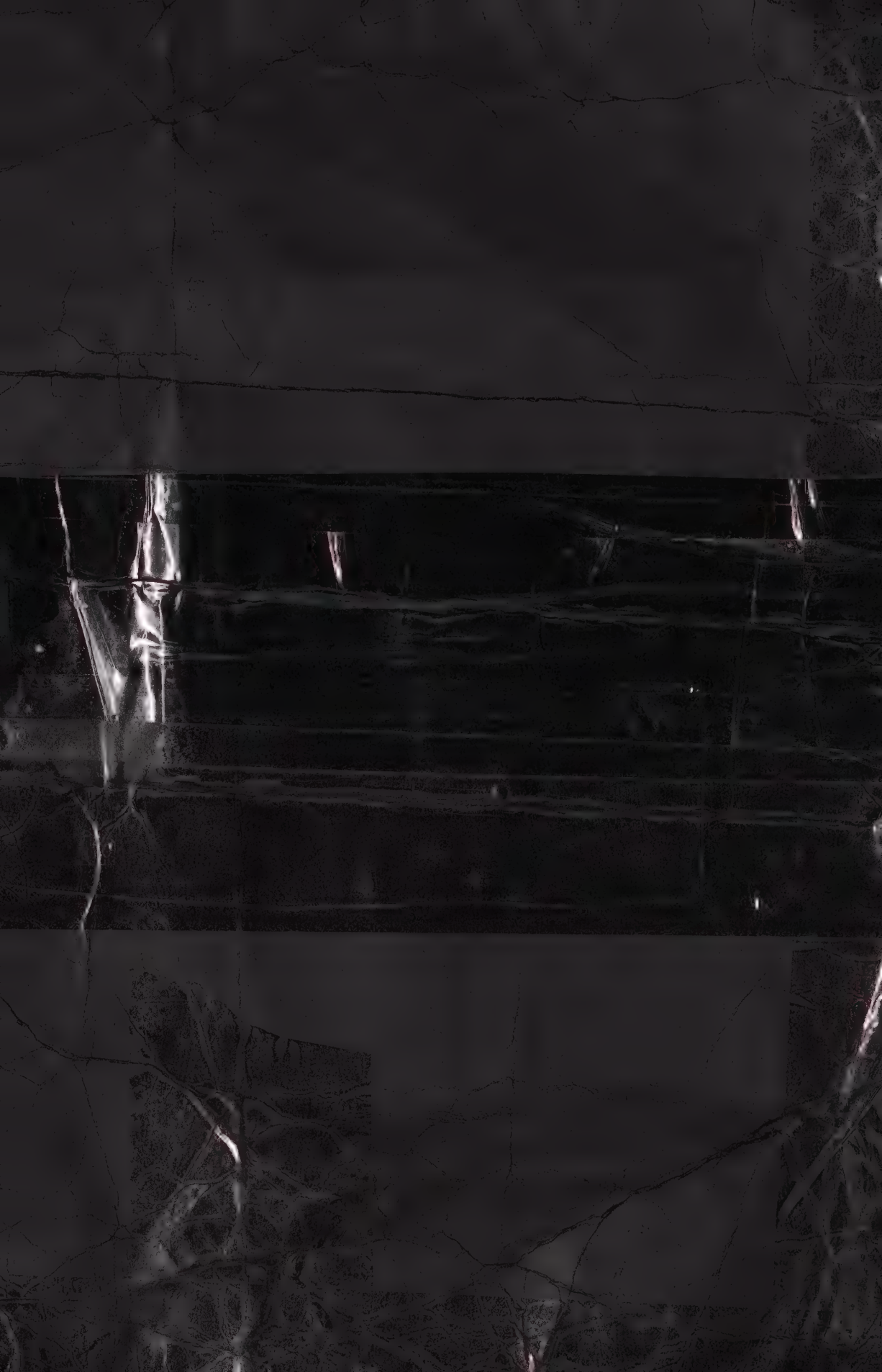
ORIGIN

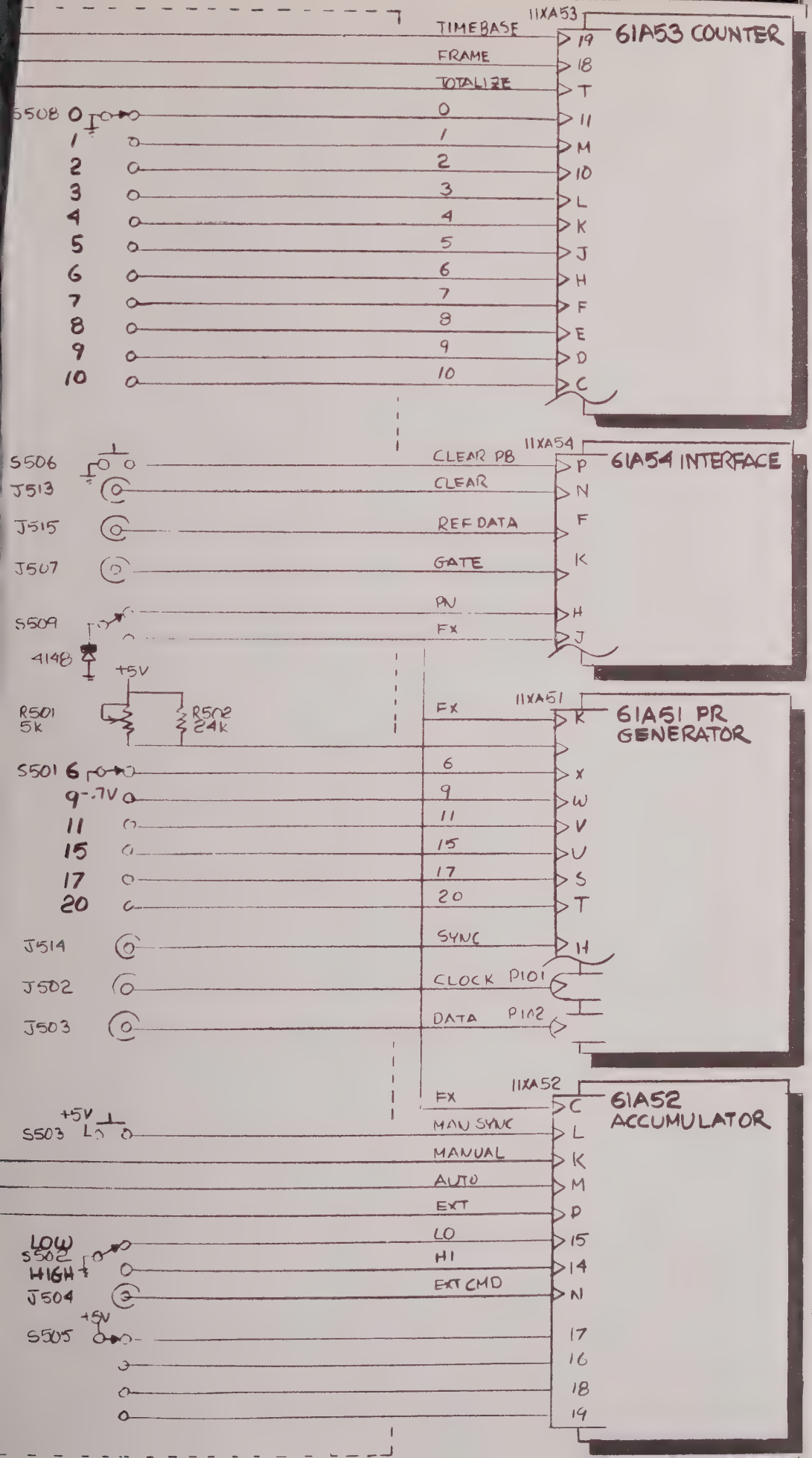
ut




61A53 COUNTER
11XA53
GATE TIME
R
A'
V
B'
W
C'
U
D'
X
CLEAR
N
LATCH
P505
10
14
16
13
12
11
9
61A32 DI
OVER FLOW
P302
TB OUT
J508
TIME
SYNC OUT
J505
SY
P301
61A54 INTERFACE
11XA54
U
OUT OF SYNC
X
J512
OU
61A51 PR GENERATOR
11XA51
9
-5.2V
10
13
-5.2V
14
11
-5.2V
12
16
-5.2V
15
DS501 5023
DS504 5023
CL
DS505 5023
DS506 5023
D
61A52 ACCUMULATOR
11XA52
J
DS503 5023
BUR
H
DS502 5023
P202
J506
ER
J501
CL
P204

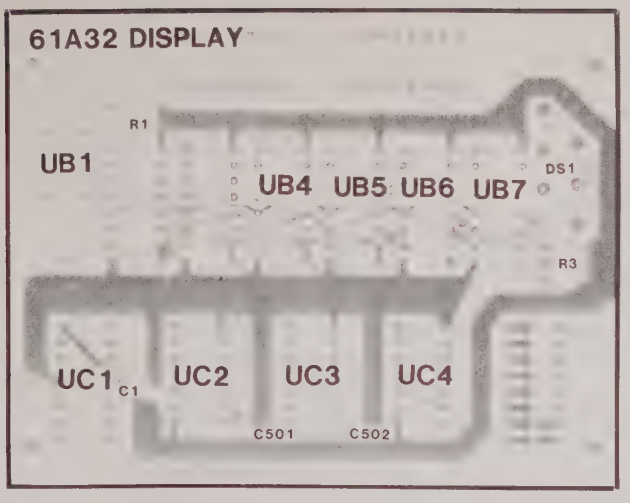

SPLAY
ERROR COUNT
Measurement Mode
S507
TIME RATE
FRAME
TOTALIZE
TIME BASE
BASE OUT
UC OUT
61A31 FRONT PANEL
CLEAR
DATA IN
GATE IN
PN
FX
PHASE
CODE LENGTH
RUN
CK TRGD
HASED
TA TRGD
SYNC IN
CLK IN
DATA IN
ST ERROR
S504
MANUAL
Sync Mode
MANUAL
AUTO
EXT CMMND
SYNC
OR OUT
CK OUT
THRESHOLD
EXT CMMND
BLOCK RATE



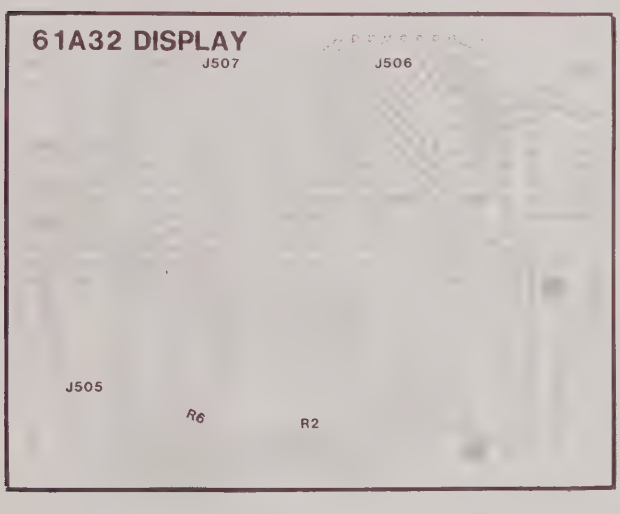


Form 0155-1081C
TAU-TRON
M8HA
1 of 1 **61A31**
FRONT PANEL

61-607



IC SIDE



NON-IC SIDE

PART

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L in

R in

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REFE

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SIGNA

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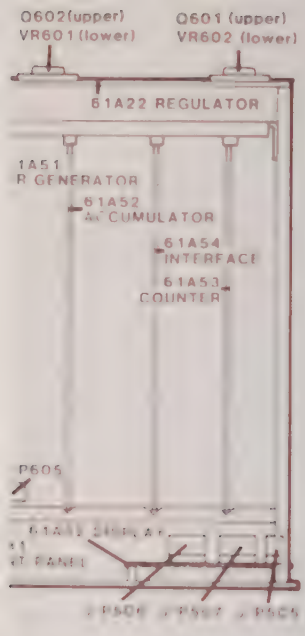
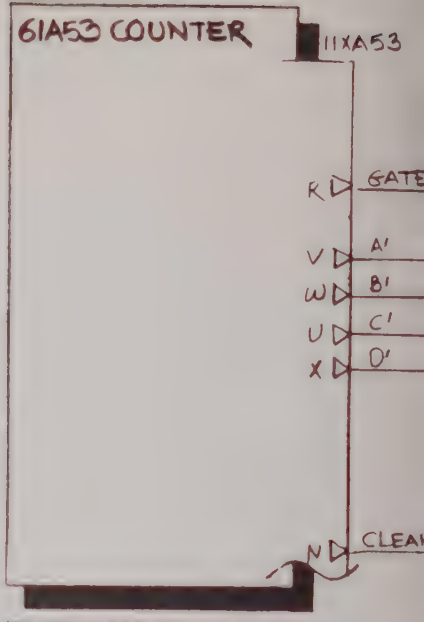
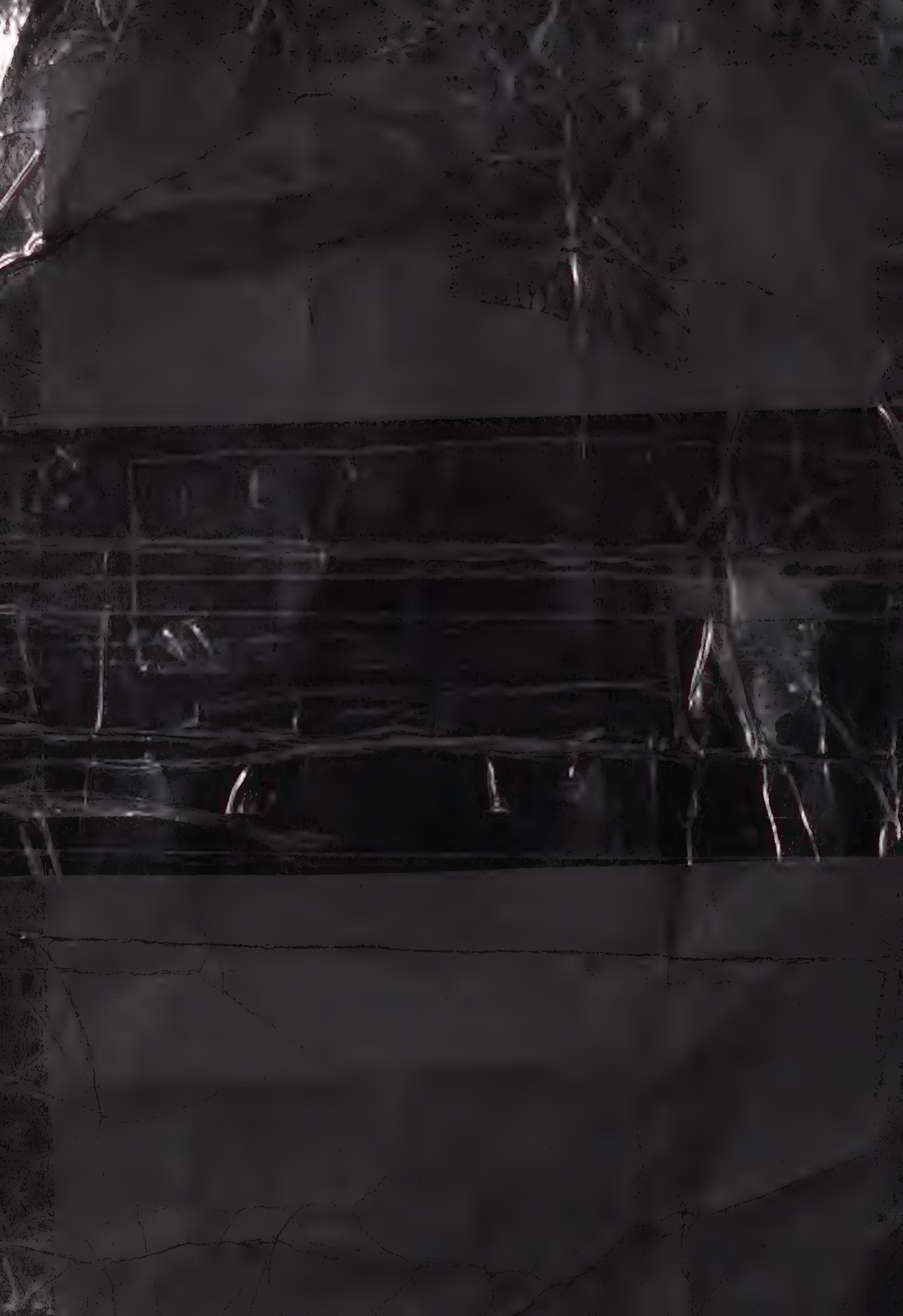


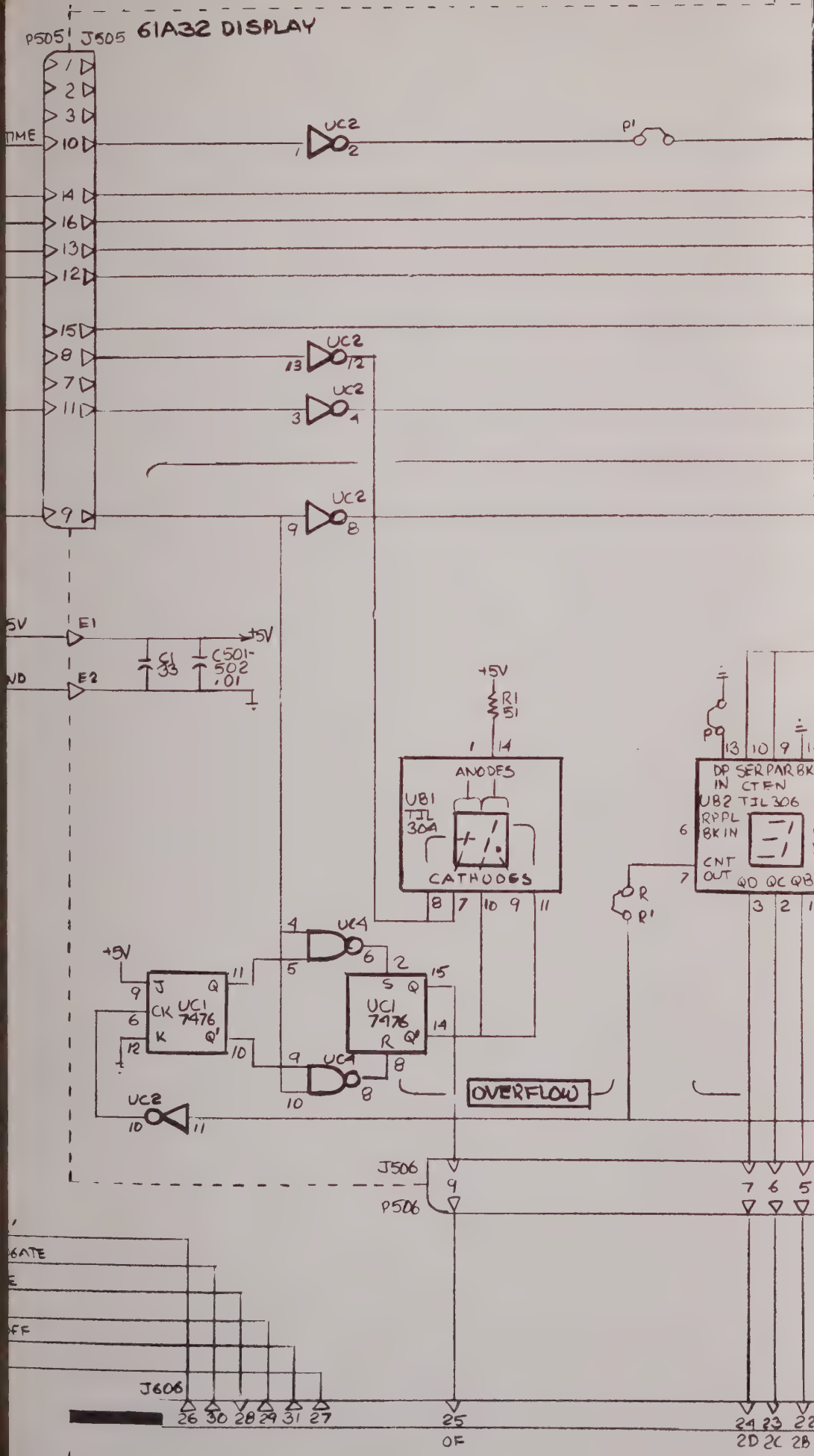


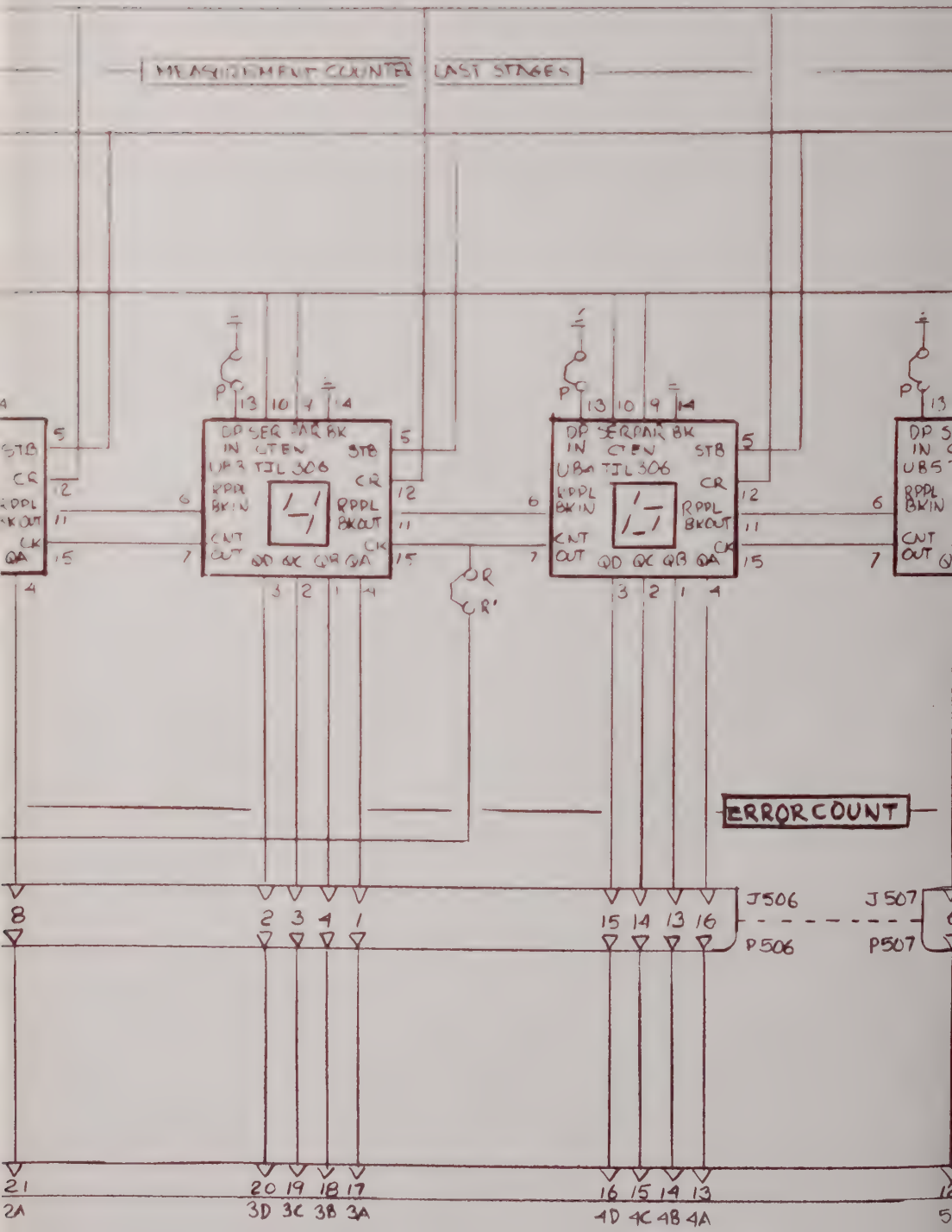
S VALUES

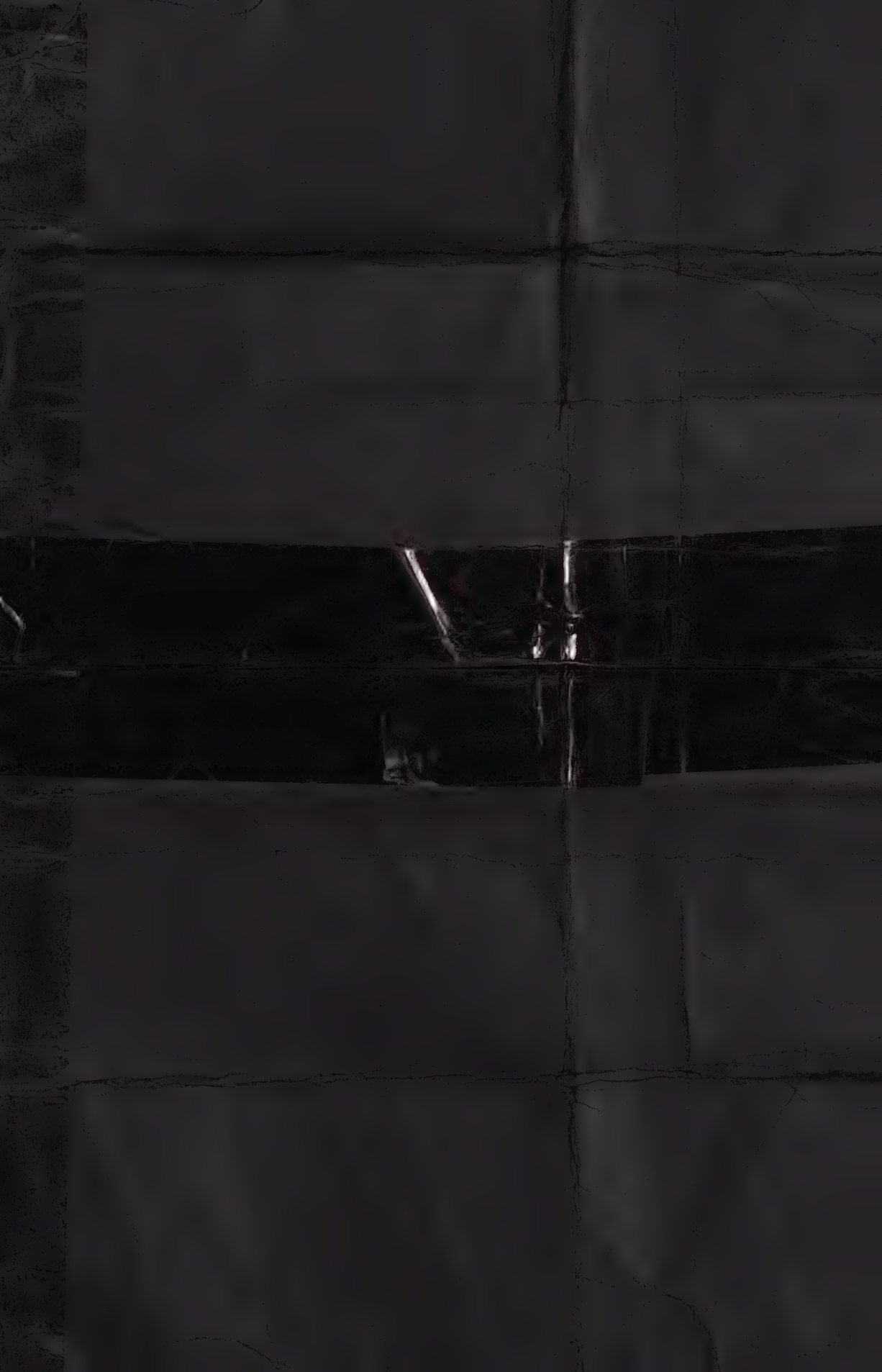
RENCE DESIGNATIONS

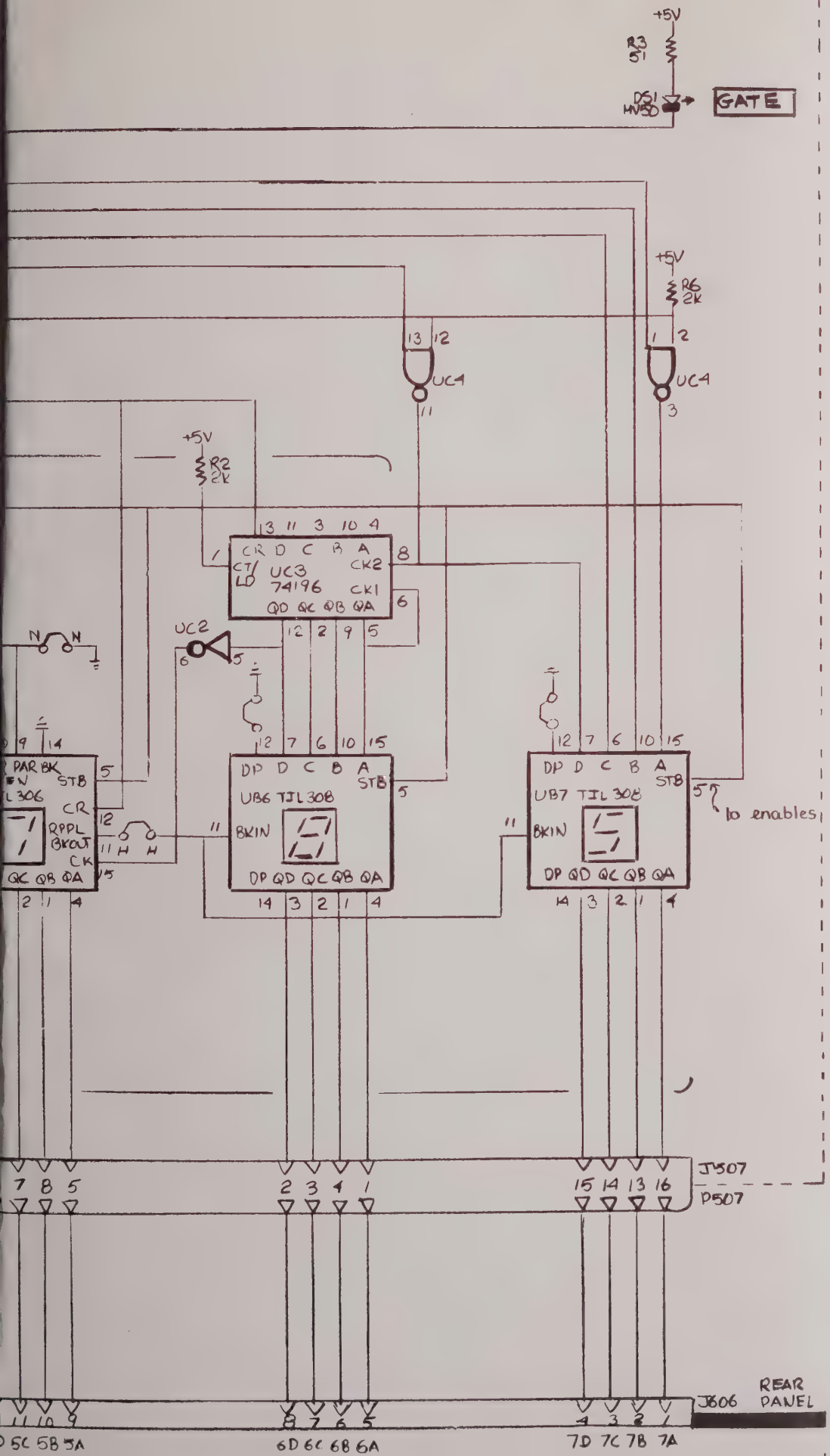
L ORIGIN




61A32 DISPLAY
P505
J505
UC2
P1
+5V
E1
E2
C1 33
C501-502 .01
R1 51
ANODES
UB1 TIL 304
CATHODES
DP IN
SER
PAR
BK IN
CTEN
UB2 TIL 306
RPPL BK IN
CNT OUT
QD QC QB
R
R'
UC4
UC1 7476
J
CK
K
Q
Q'
S
R
OVERFLOW
J506
P506
J606
26 30 28 29 31 27
25
OF
24 23 22
2D 2C 2B


MEASUREMENT COUNTER
LAST STAGES
DP SER PAR BK
IN CTEN STB
UBS TIL 306
RPPL BKIN
CR
RPPL BKOUT
CNT OUT
CK
QD QC QB QA
ERROR COUNT
J506
J507
P506
P507
8
2 3 4 1
15 14 13 16
21
20 19 18 17
16 15 14 13
2A
3D 3C 3B 3A
4D 4C 4B 4A



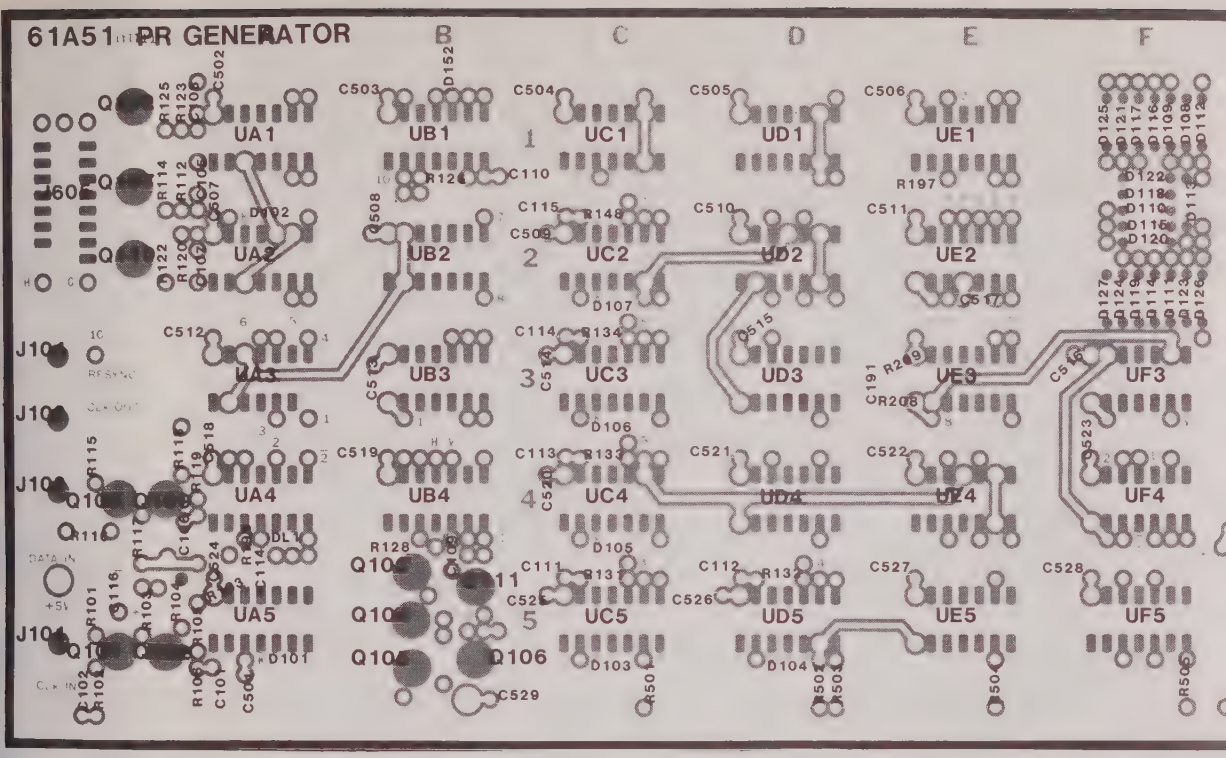


TCJ-53014
REV 3

Form 155-1081C
TAU-TRON
MB-1A

1 of 1 **61A32**
DISPLAY

61-609


61A51 PR GENERATOR
B
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UB1
UC1
UD1
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UE2
UA3
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J104
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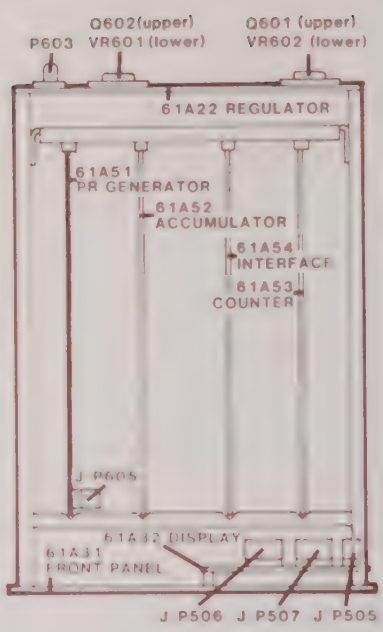


IC SIDE

NON-IC SIDE

PARTS VALUES

Unless noted otherwise
C in μF
L in μH
R in Ω
• special, see parts list

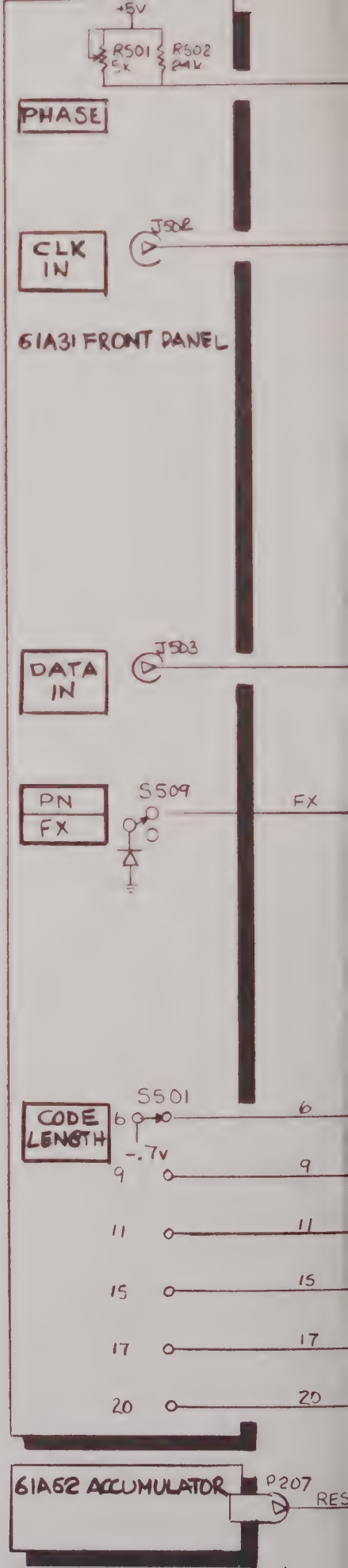
For full type numbers of ICs and transistors, see parts list

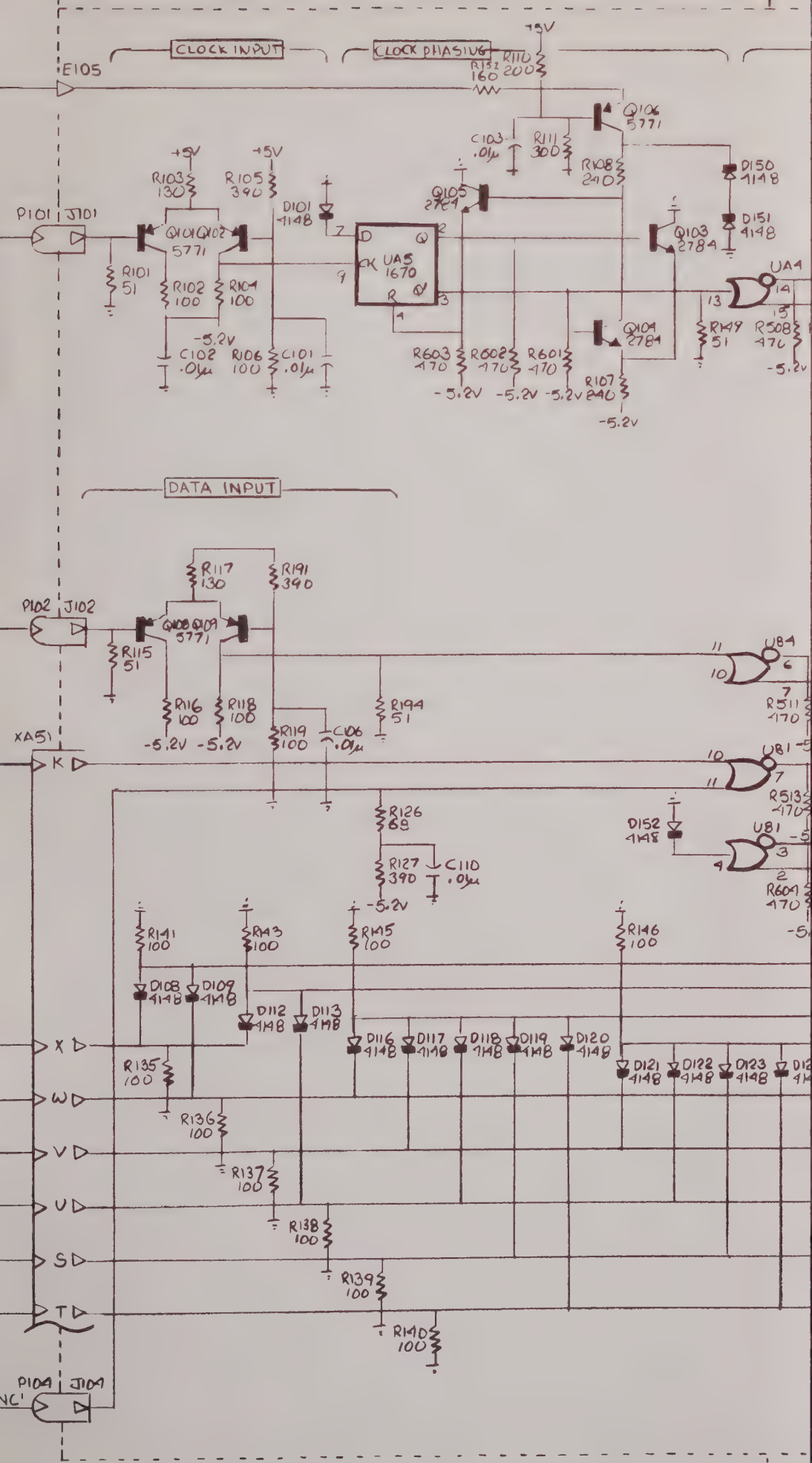
REFERENCE DESIGNATIONS

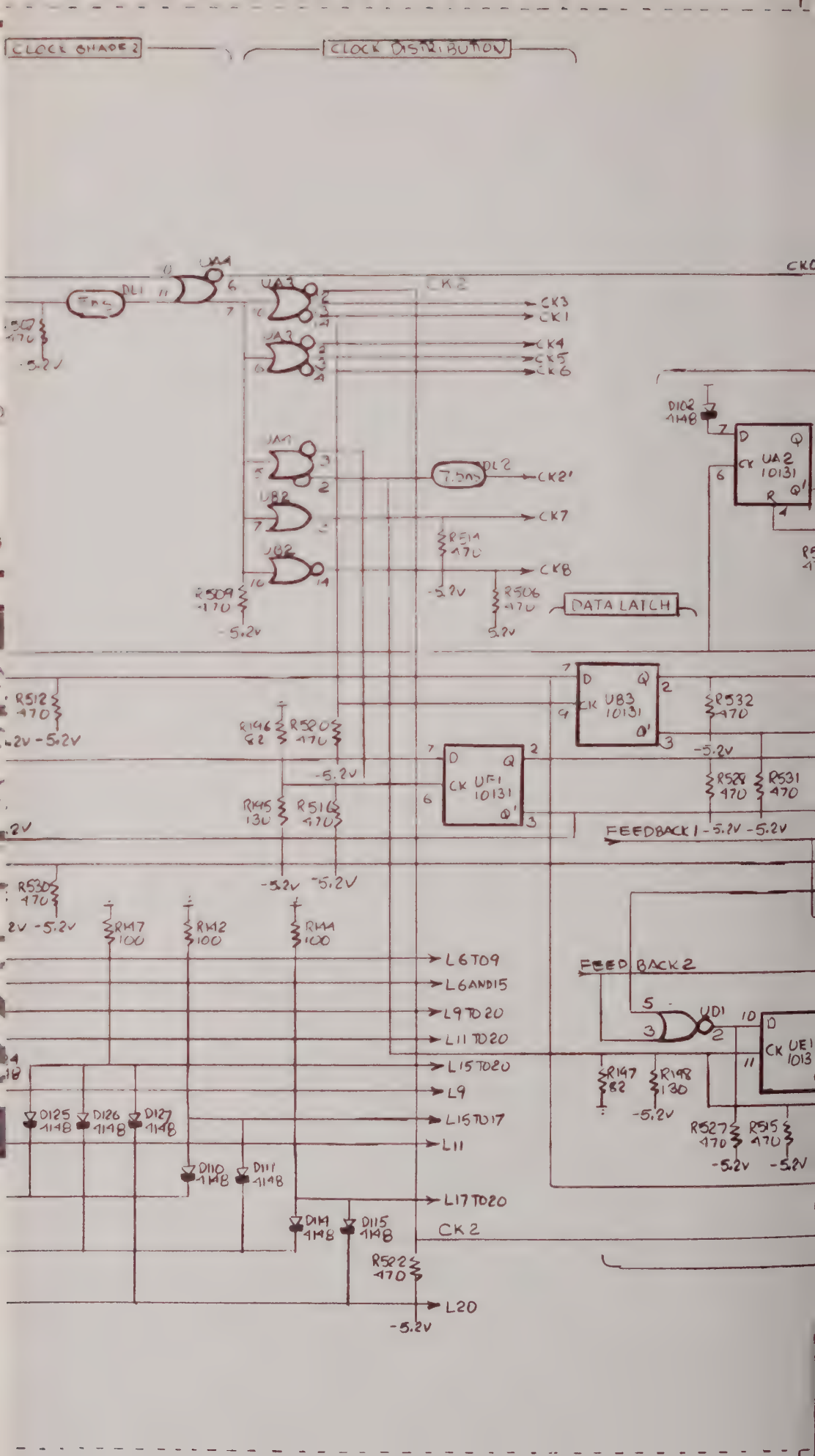
Full reference designations include assembly prefix

SIGNAL ORIGIN

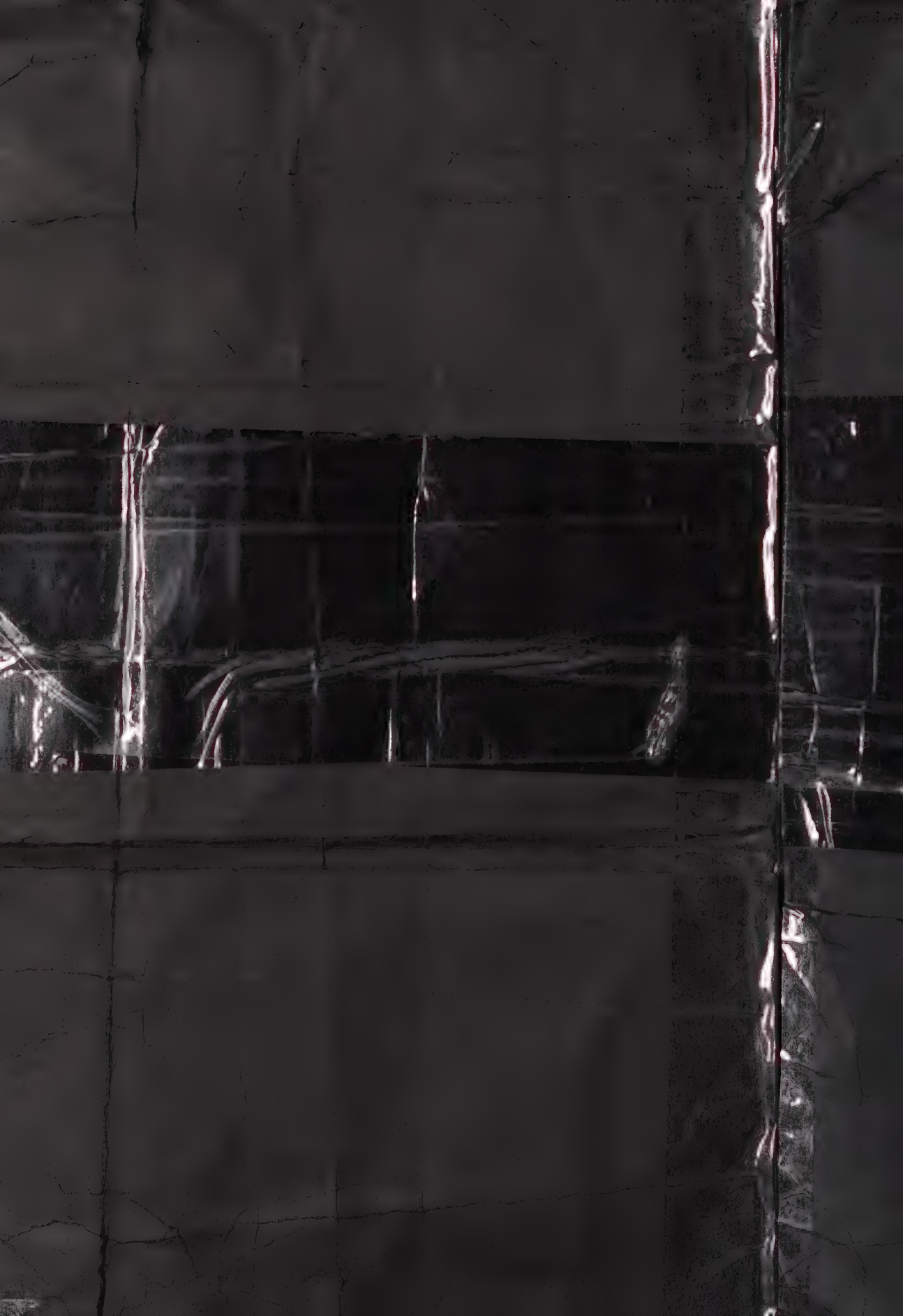
• input
▷ output

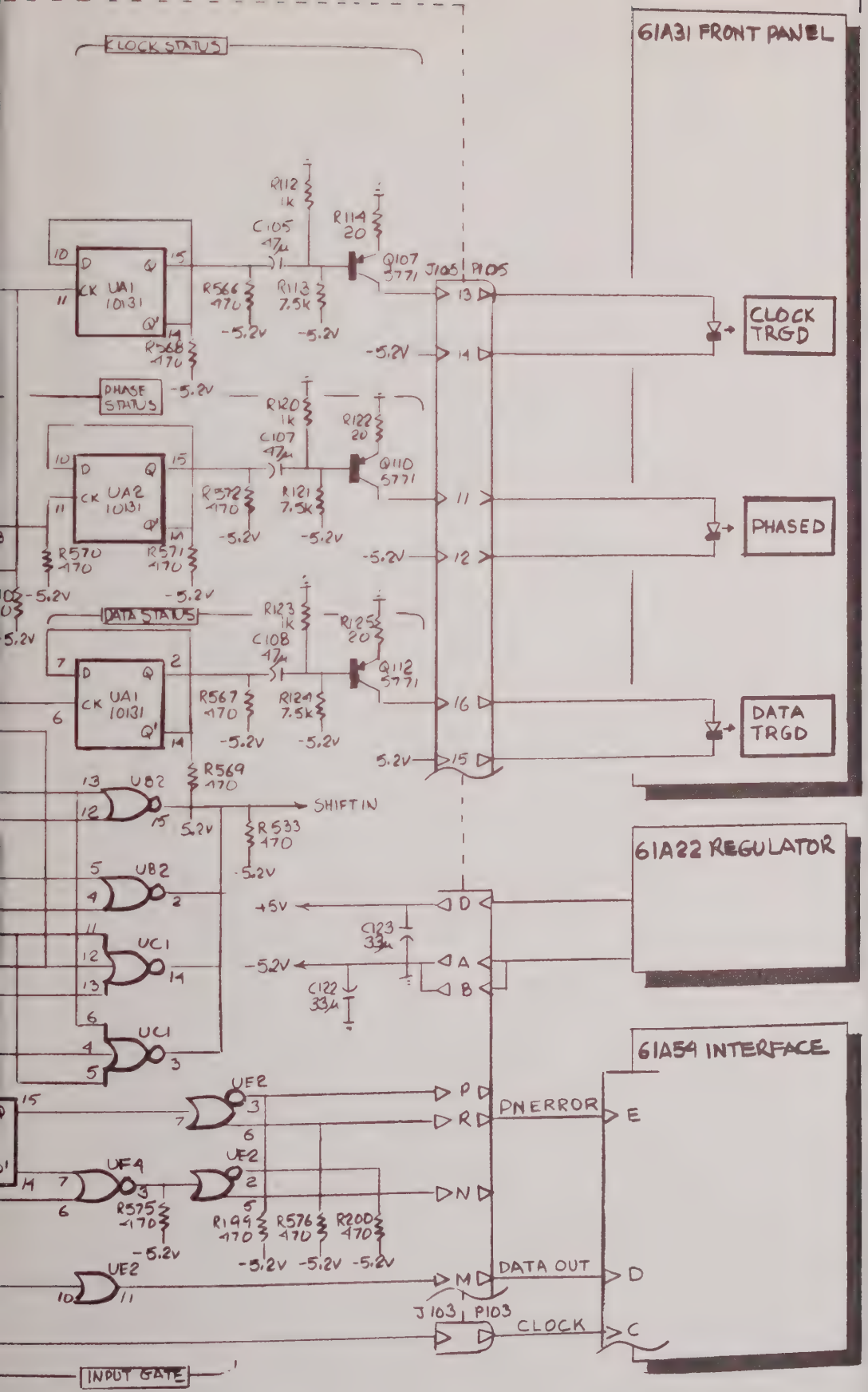



CLOCK INPUT
CLOCK PHASING
DATA INPUT
E105
+5V
R110 200
R152 160
Q106 5771
C103 .01µ
R111 300
R108 240
D150 4148
D151 4148
Q103 2784
Q105 2784
Q104 2784
R107 240
P101 J101
Q101 Q102 5771
R103 130
R105 390
D101 4148
R101 51
R102 100
R104 100
C102 .01µ
R106 100
C101 .01µ
-5.2V
UA5 1670
UA4
R603 470
R602 470
R601 470
R509 51
R508 470
P102 J102
Q108 Q109 5771
R117 130
R191 390
R115 51
R116 100
R118 100
R119 100
C106 .01µ
R194 51
UB4
R511 470
XA51
K
UB1
R513 470
R126 68
R127 390
C110 .01µ
D152 4148
R604 470
R141 100
R143 100
R145 100
R146 100
D108 4148
D109 4148
D112 4148
D113 4148
D116 4148
D117 4148
D118 4148
D119 4148
D120 4148
D121 4148
D122 4148
D123 4148
X
W
V
U
S
T
R135 100
R136 100
R137 100
R138 100
R139 100
R140 100
P104 J104
NC



CLOCK SHAPE 2
CLOCK DISTRIBUTION
UA4
DL1
UA3
CK2
CK3
CK1
CK4
CK5
CK6
UA4
UB2
DL2
7.5ns
CK2'
CK7
CK8
R514 470
R509 470
R506 470
-5.2V
5.2V
DATA LATCH
D102 4148
UA2 10131
UB3 10131
UF1 10131
R512 470
R196 82
R520 470
R195 130
R516 470
R532 470
R528 470
R531 470
FEEDBACK 1
R530 470
R147 100
R142 100
R144 100
L6 TO 9
L6 AND 15
L9 TO 20
L11 TO 20
L15 TO 20
L9
L15 TO 17
L11
L17 TO 20
CK 2
D125 4148
D126 4148
D127 4148
D110 4148
D111 4148
D114 4148
D115 4148
R522 470
L20
FEED BACK 2
UD1
UE1 1013
R197 82
R198 130
R527 470
R515 470

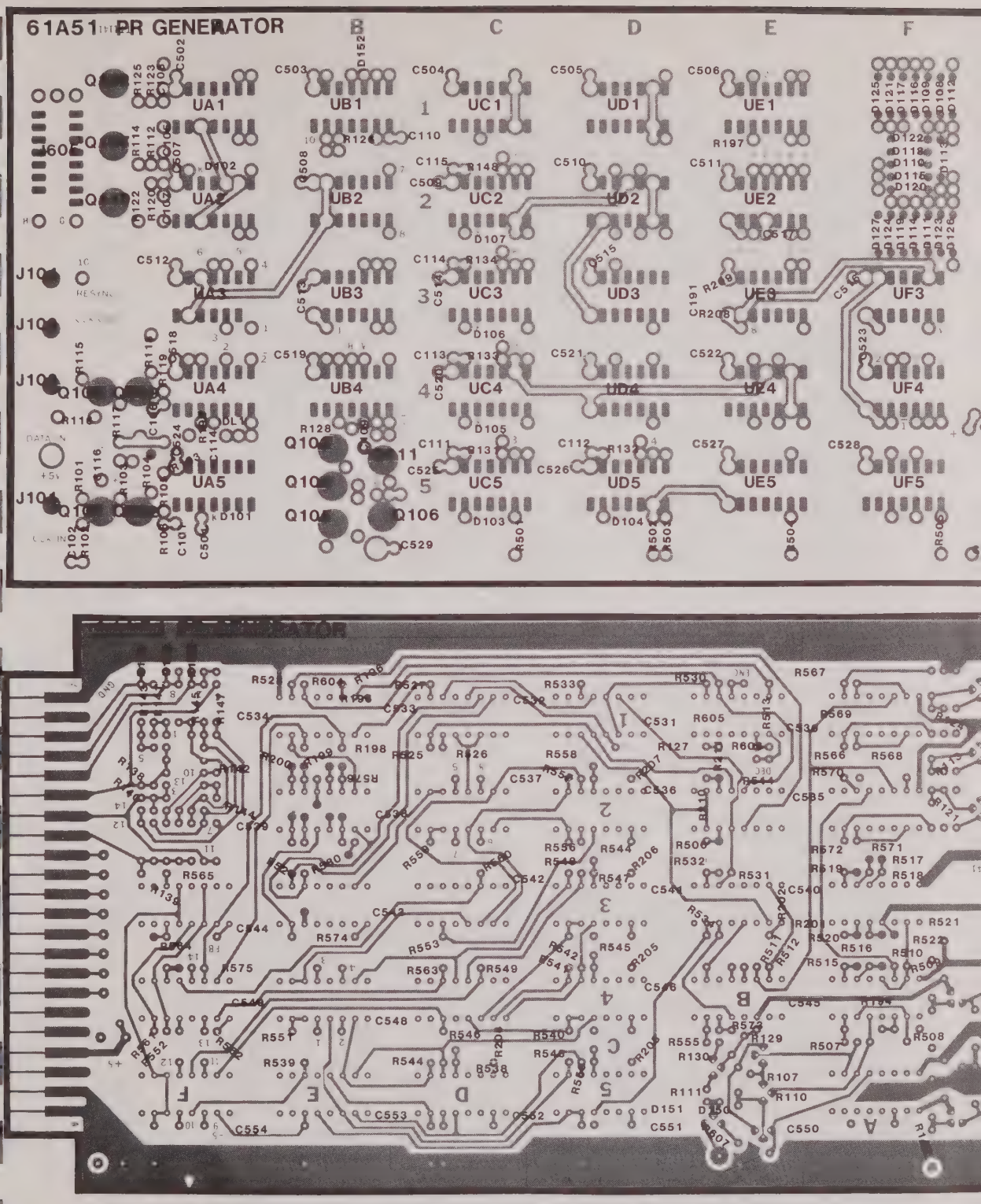




TDJ-53617
REV5

Form 155-1081C
TAU-TRON
MB-1A

1of2 **61A51**
PR GENERATOR


61A51 PR GENERATOR
B
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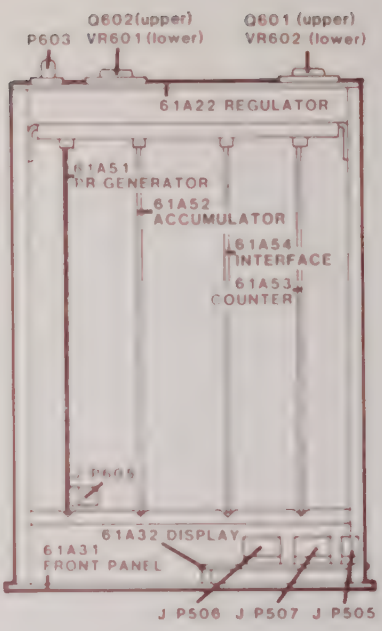
UA1
UB1
UC1
UD1
UE1
UA2
UB2
UC2
UD2
UE2
UA3
UB3
UC3
UD3
UE3
UA4
UB4
UC4
UD4
UE4
UF4
UA5
UB5
UC5
UD5
UE5
UF5
J101
J102
J103
J104
J105
Q101
Q102
Q103
Q104
Q105
Q106
RESYNC
DATA IN
+5V



IC SIDE

NON-IC SIDE

PARTS VALUES

Unless noted otherwise

C in μF

L in μH

R in Ω

• special, see parts list

For full type numbers of ICs and transistors, see parts list

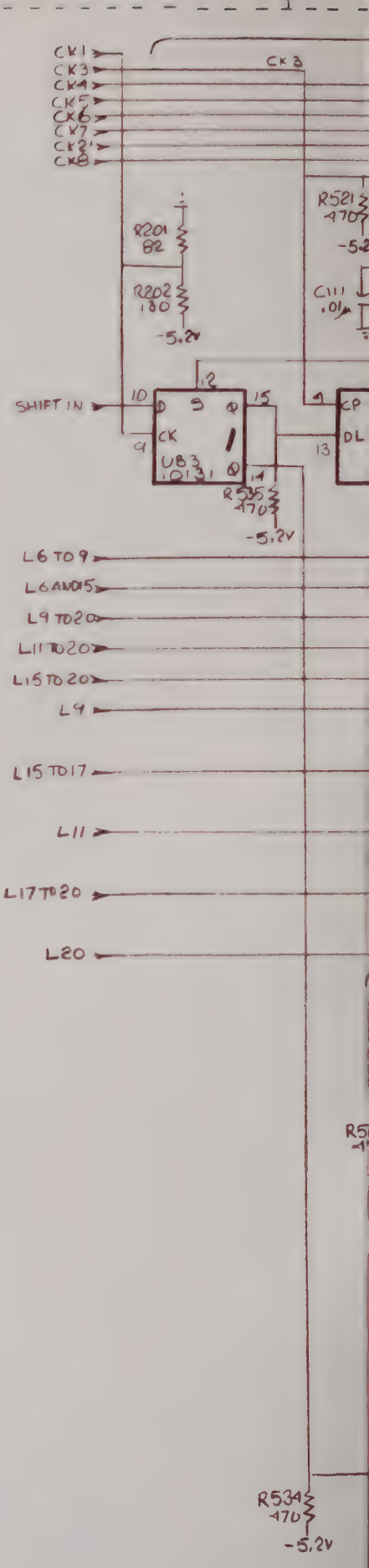
REFERENCE DESIGNATIONS

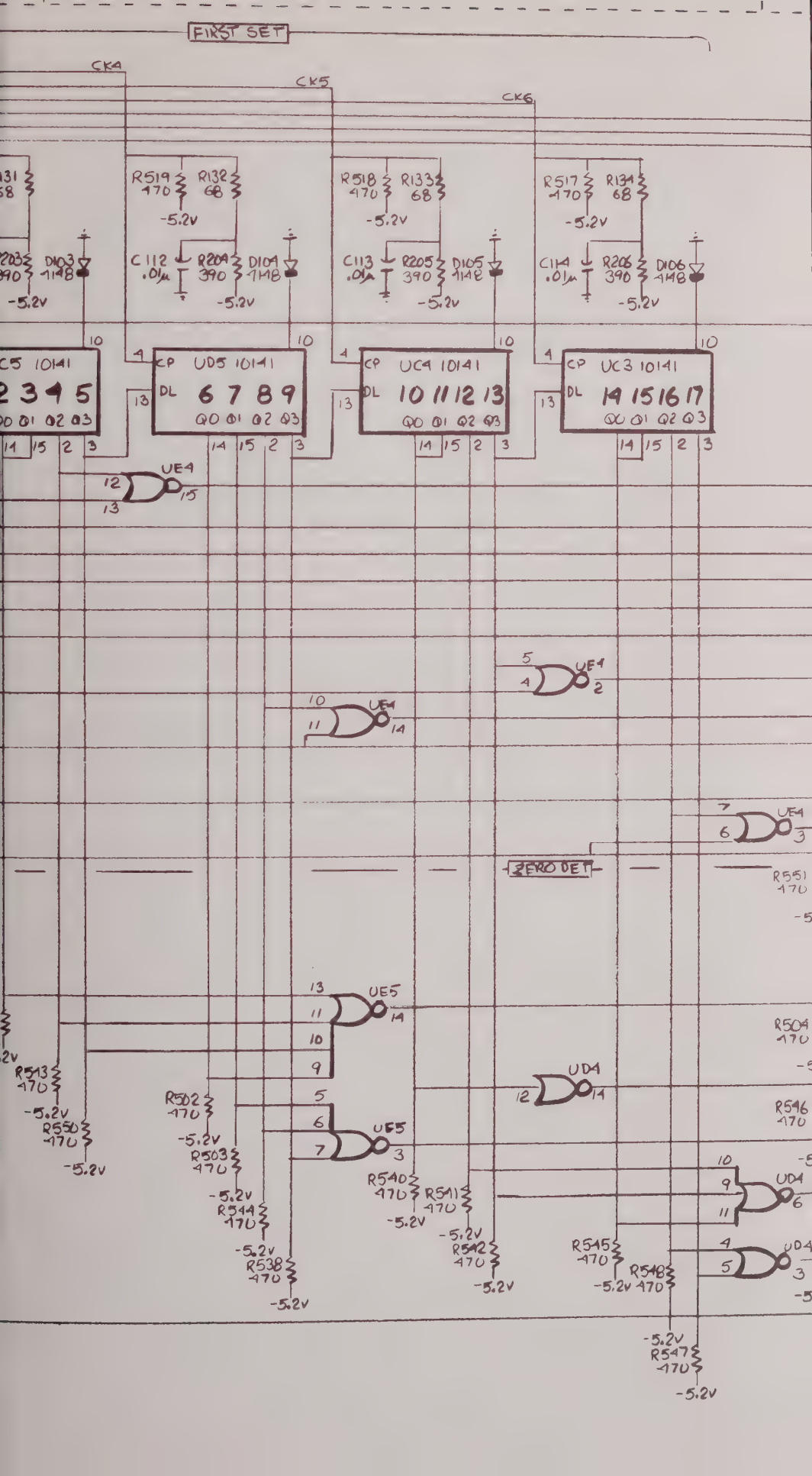
Full reference designations include assembly prefix

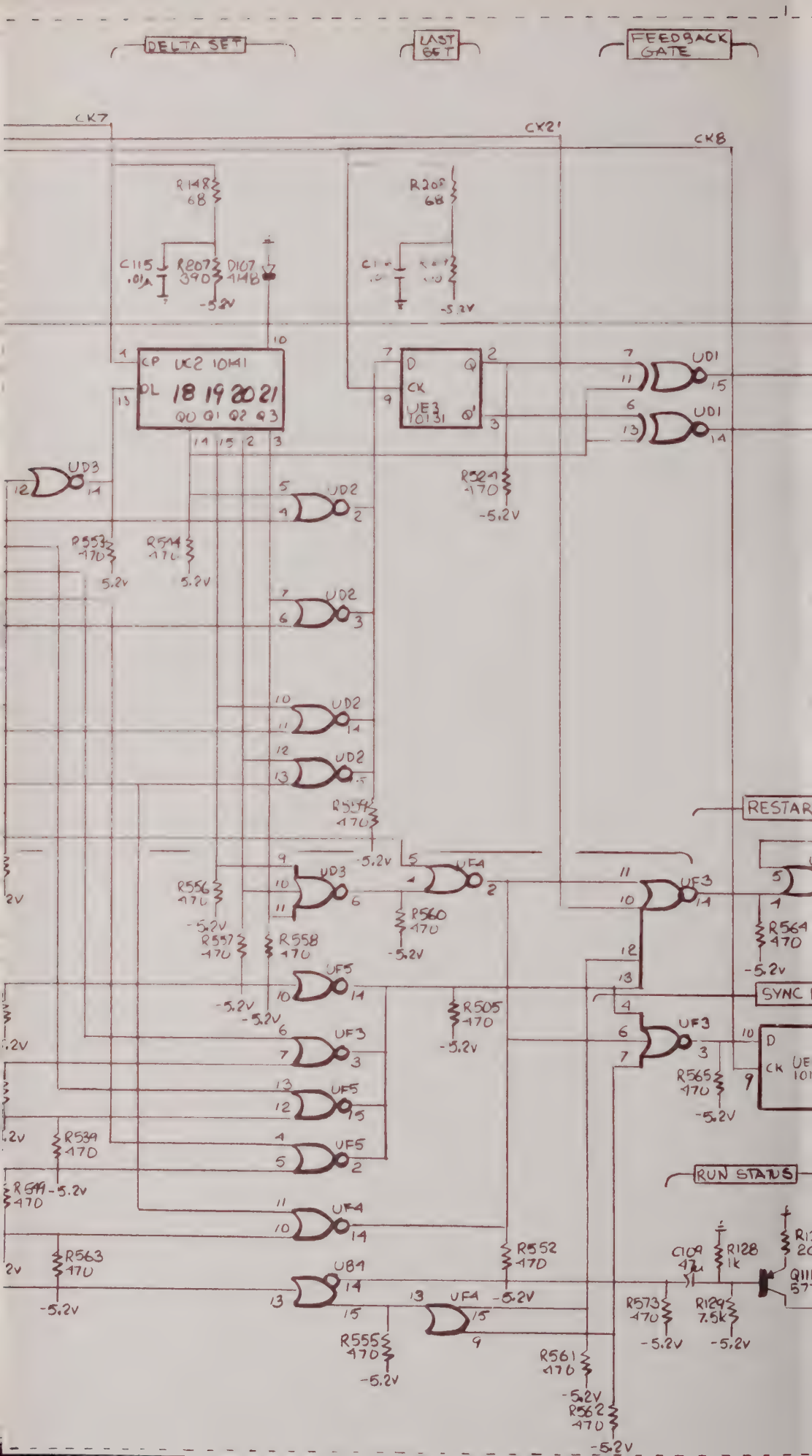
SIGNAL ORIGIN

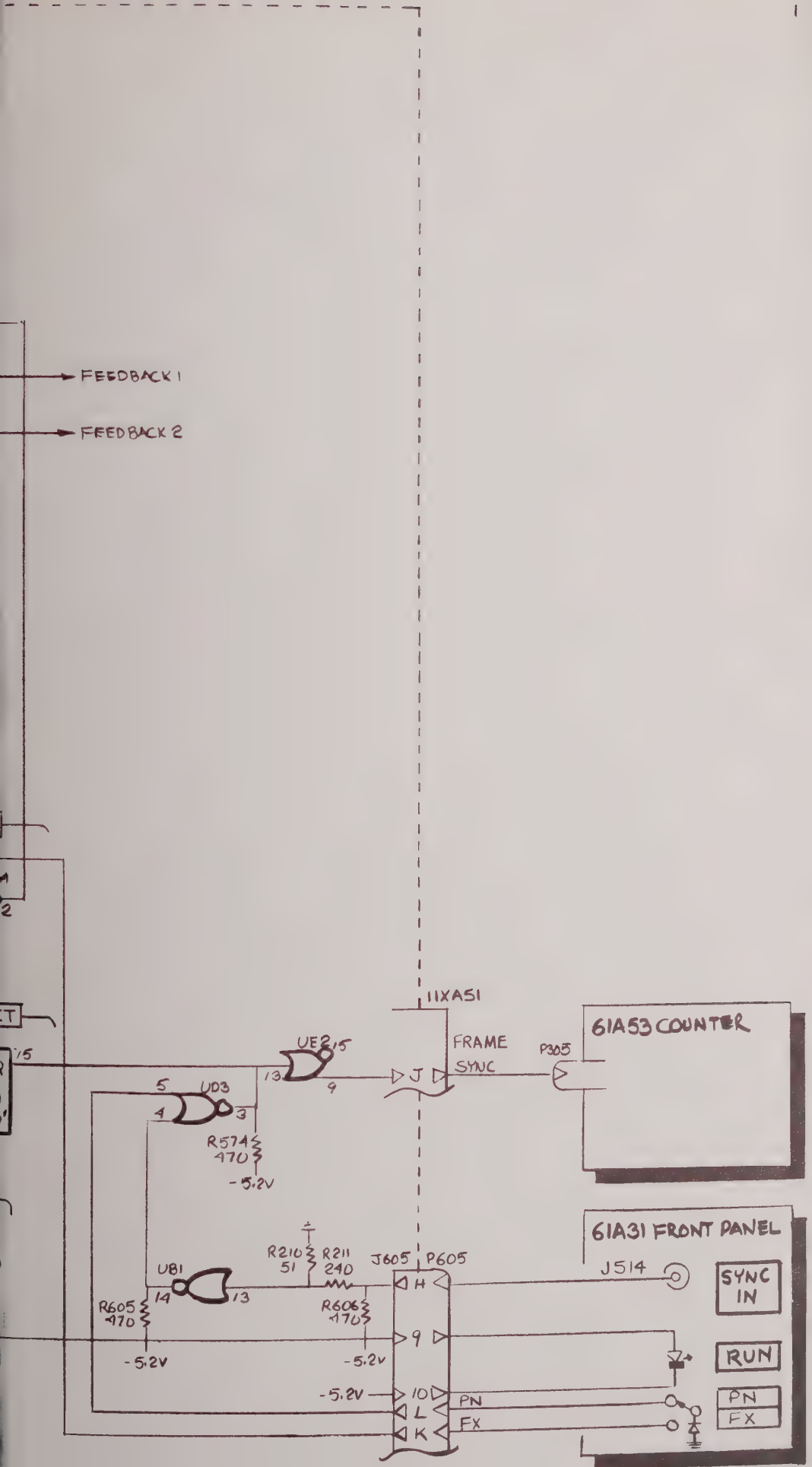
>— input

▷ output




FIRST SET
CK4
CK5
CK6
R519 470
R132 68
-5.2V
C112 .01μ
R204 390
D104 1N48
R518 470
R133 68
C113 .01μ
R205 390
D105 1N48
R517 470
R134 68
C114 .01μ
R206 390
D106 1N48
UC5 10141
UD5 10141
UC4 10141
UC3 10141
CP
DL
Q0 Q1 Q2 Q3
UE4
UE5
UD4
ZERO DET
R513 470
R550 470
R502 470
R503 470
R544 470
R538 470
R540 470
R541 470
R542 470
R545 470
R548 470
R547 470
R551 470
R504 470
R546 470


DELTA SET
LAST SET
FEEDBACK GATE
CK7
CK2'
CK8
R148 68
C115 .01μ
R207 390
D107 1N48
-5.2V
R208 68
CP UC2 10H1
DL 18 19 20 21
Q0 Q1 Q2 Q3
UE3 10131
UD1
UD2
UD3
R524 470
R553 470
R554 470
5.2V
R555 470
R556 470
R557 470
R558 470
R559 470
R560 470
UF4
UF5
UF3
R505 470
R539 470
R563 470
UB4
R552 470
R555 470
R561 470
R562 470
RESTAR
SYNC
R564 470
R565 470
RUN STATUS
C109 47μ
R128 1k
R129 7.5k
R573 470


FEEDBACK 1
FEEDBACK 2
11XA51
FRAME
SYNC
P305
61A53 COUNTER
UE2
15
13
9
J
UD3
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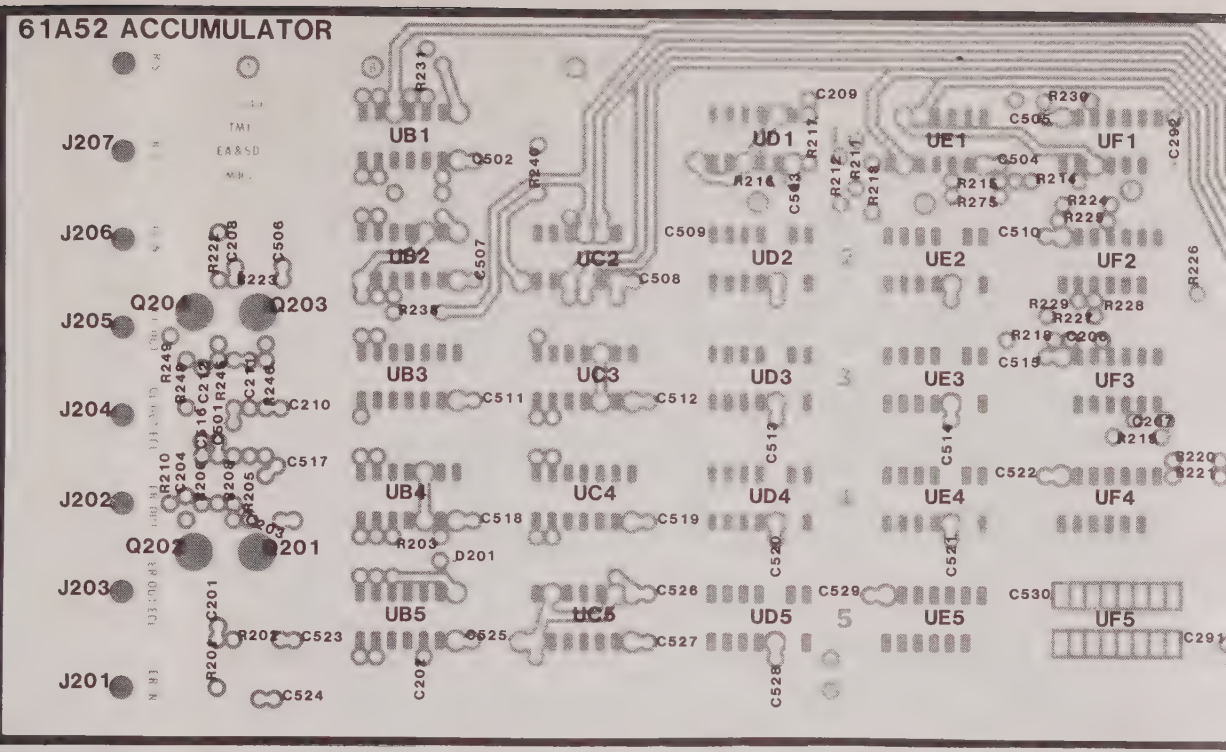
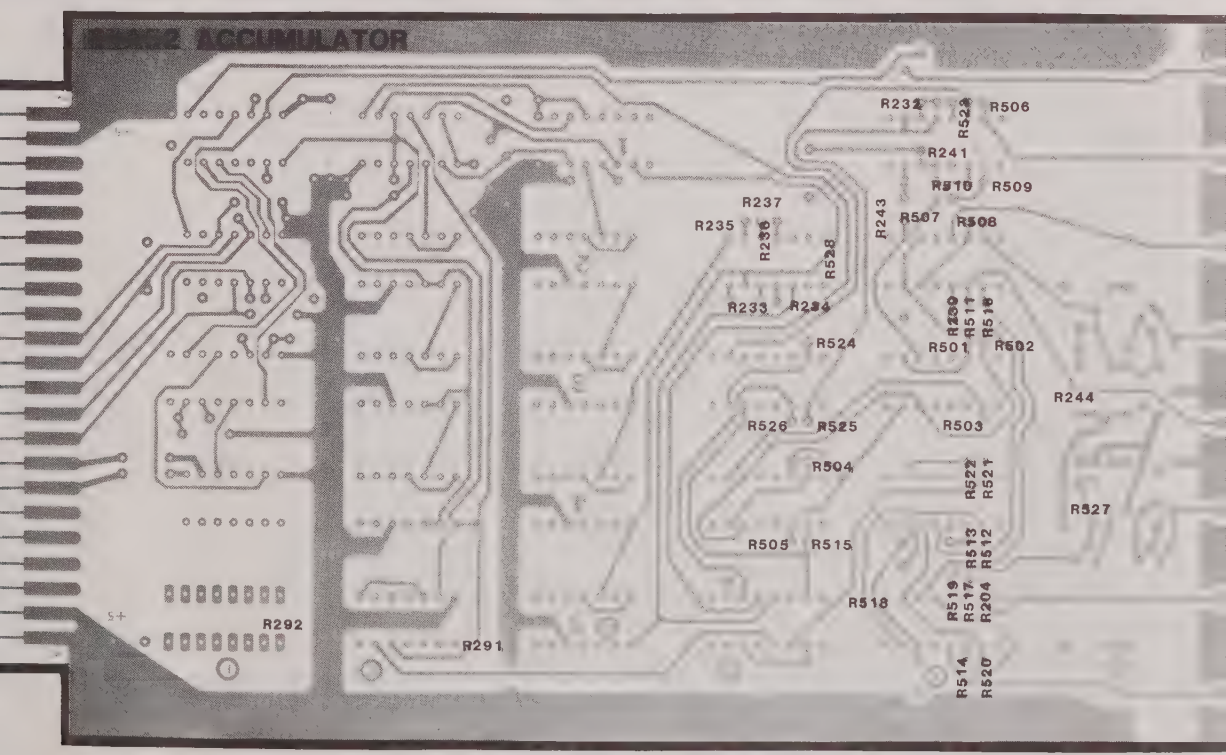
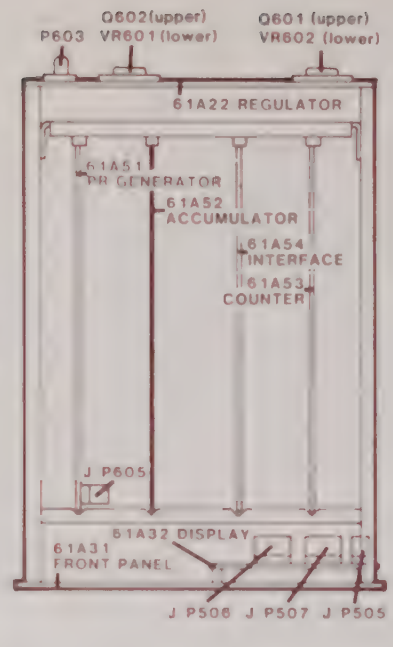
3
R574
470
-5.2V
61A31 FRONT PANEL
R210
51
R211
240
J605
P605
J514
SYNC
IN
UB1
14
13
R605
470
R606
470
H
9
RUN
-5.2V
-5.2V
-5.2V
10
L
K
PN
FX
PN
FX
TDJ-53617
REV5
Form 155-1081C
TAU-TRON
M8-1A
2of2 61A51
PR GEUERATOR
61-613


61A52 ACCUMULATOR
J207
J206
J205
J204
J202
J203
J201
Q200
Q203
Q202
Q201
UB1
UC1
UD1
UE1
UF1
UB2
UC2
UD2
UE2
UF2
UB3
UC3
UD3
UE3
UF3
UB4
UC4
UD4
UE4
UF4
UB5
UC5
UD5
UE5
UF5


61A52 ACCUMULATOR
R292
R291



IC SIDE

NON-IC SIDE

PARTS VALUES

Unless noted otherwise

C in μf

L in μH

R in Ω

· special, see parts list

For full type numbers of ICs and transistors see parts list

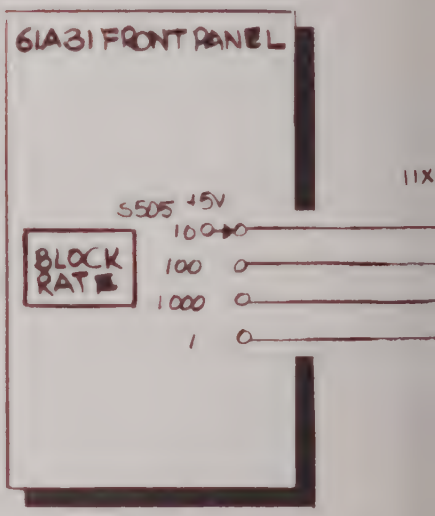
REFERENCE DESIGNATIONS

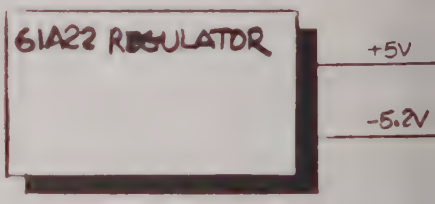
Full reference designations include assembly prefix

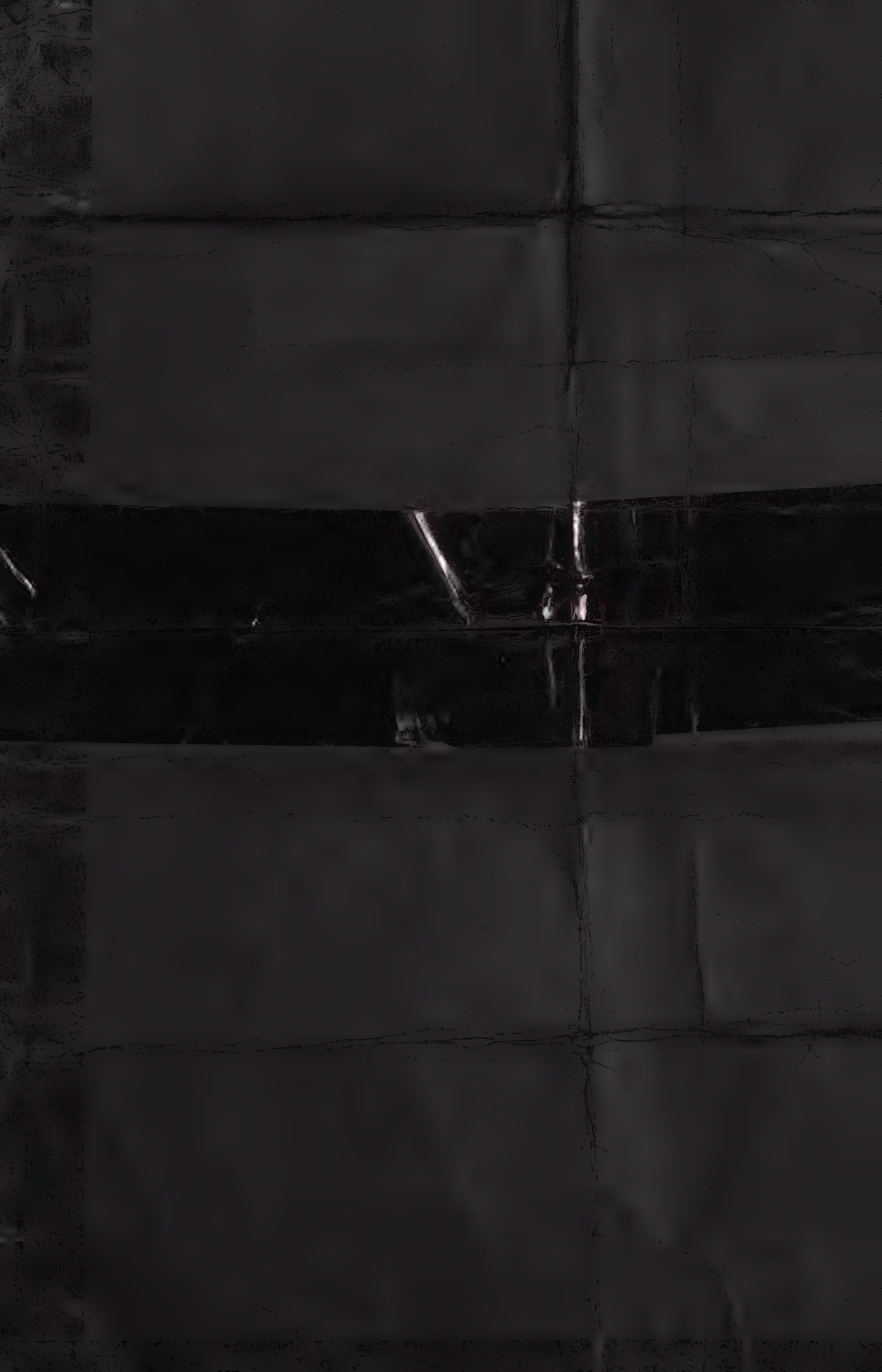
SIGNAL ORIGIN

⊢ input

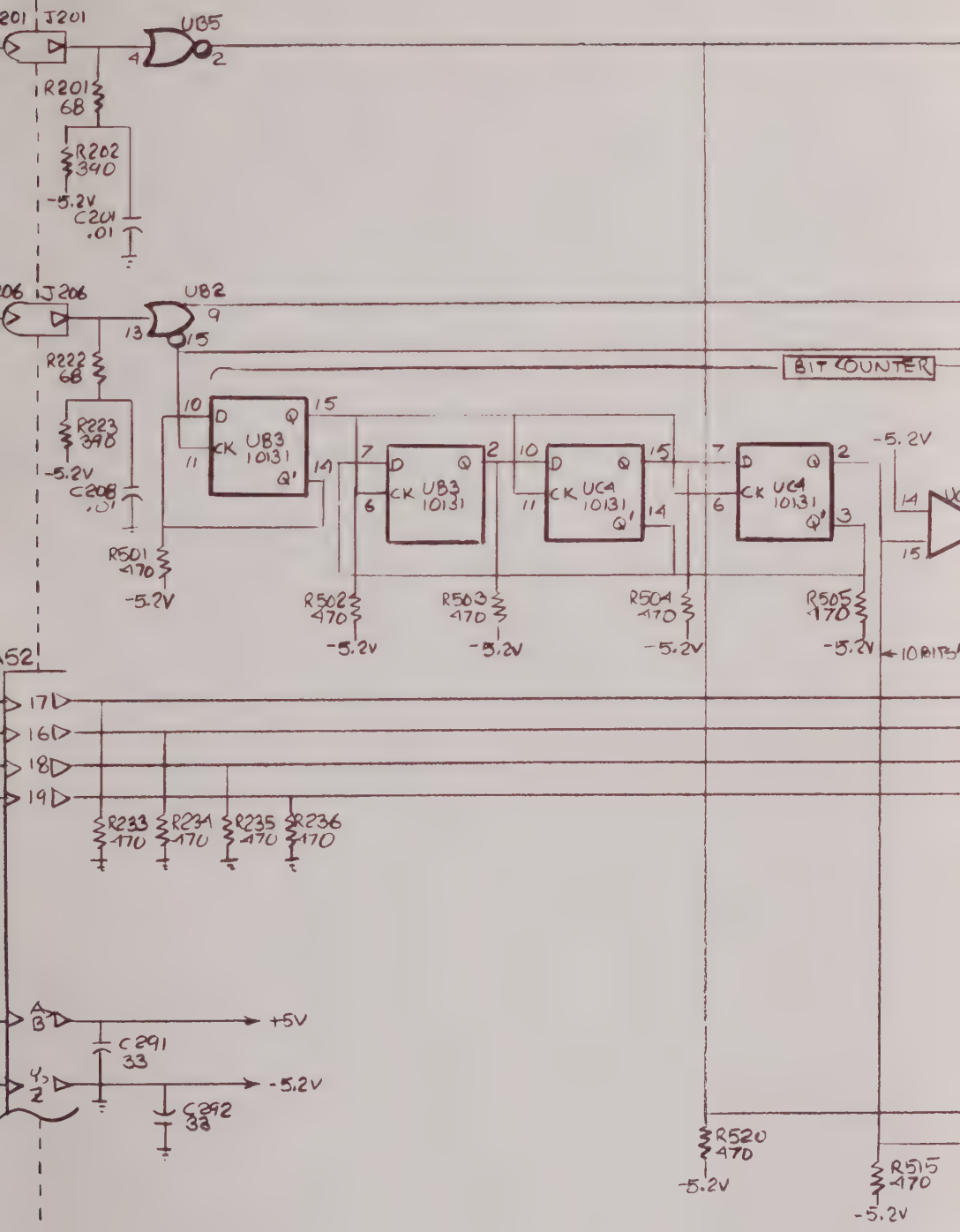
▷ output

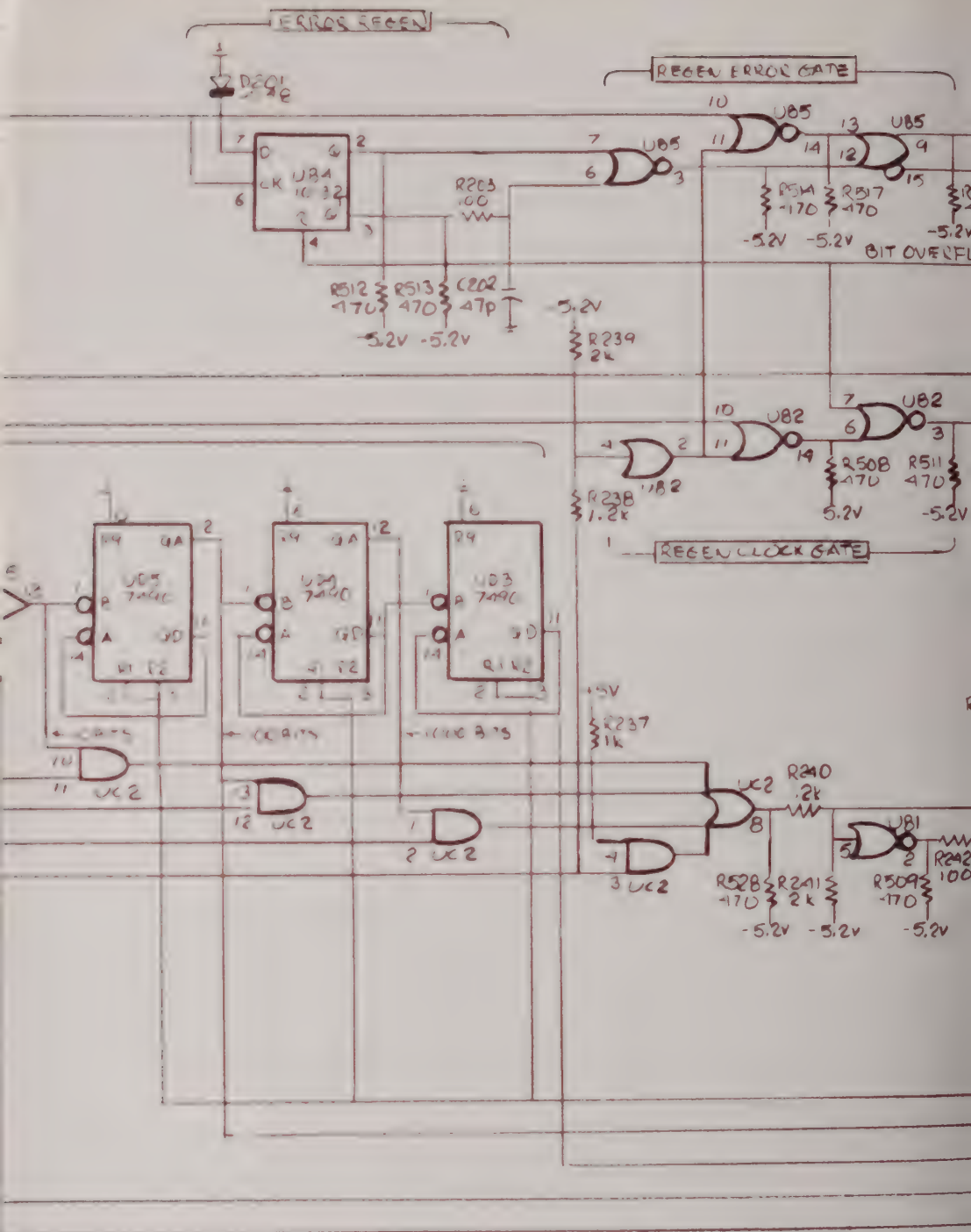


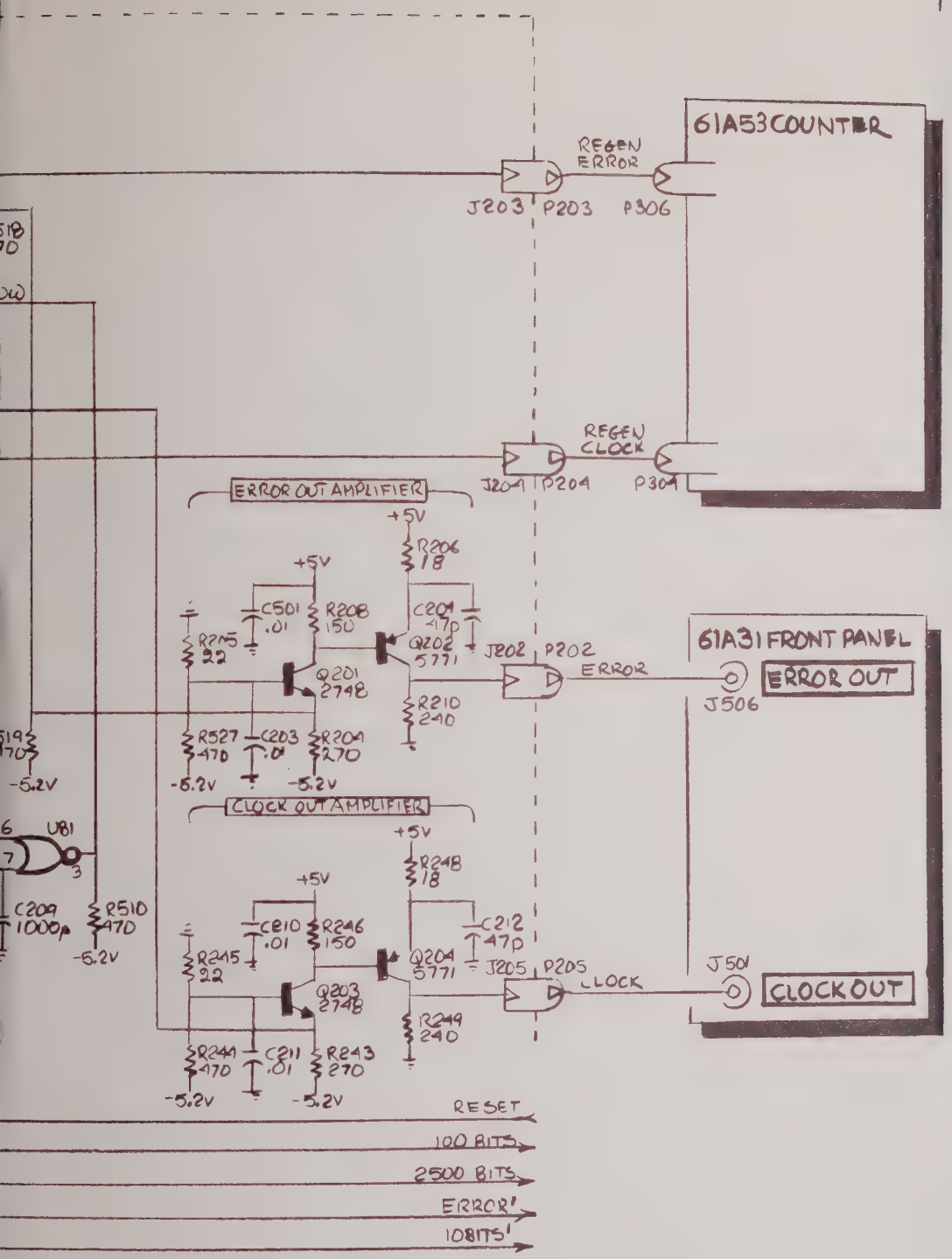


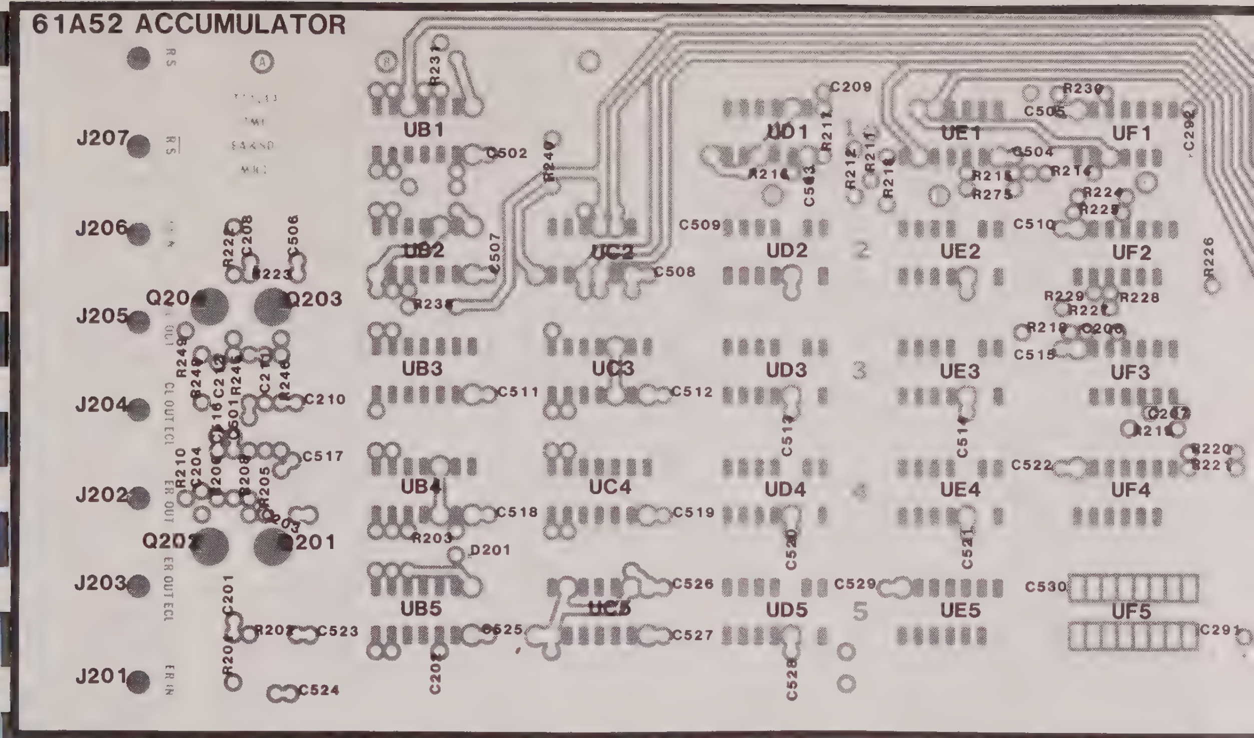


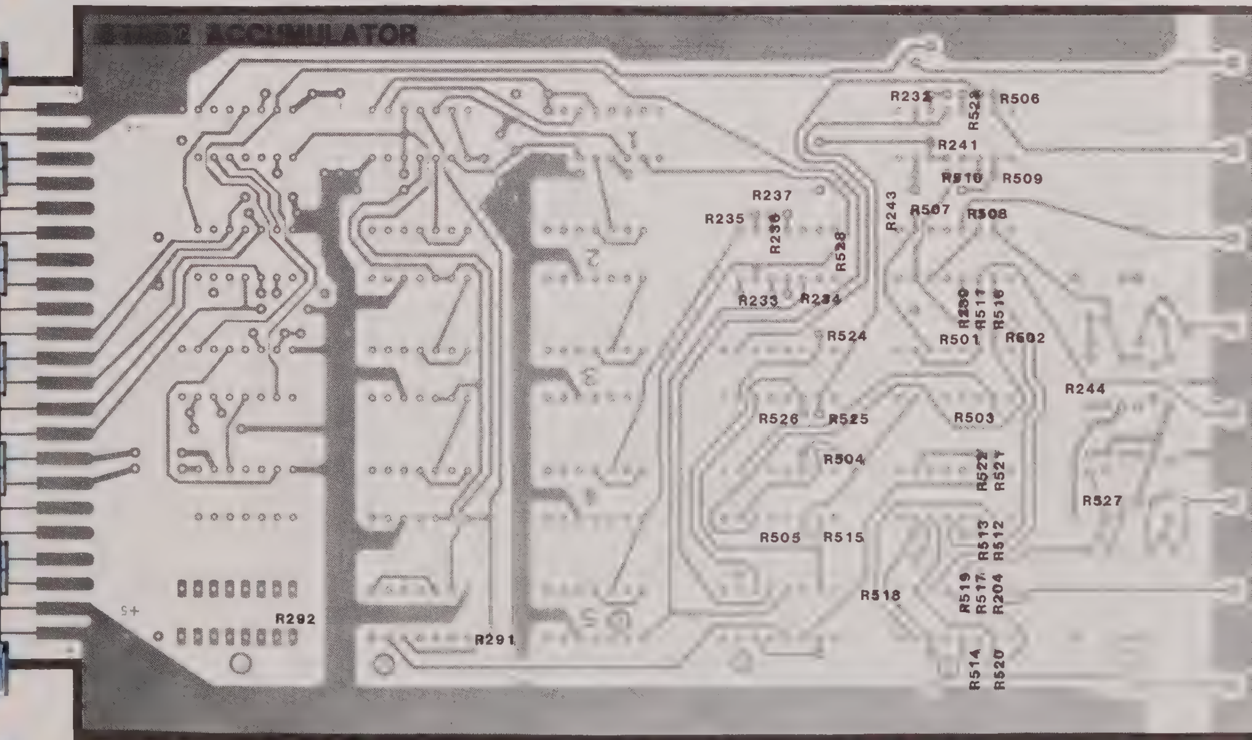
61A52 ACCUMULATOR

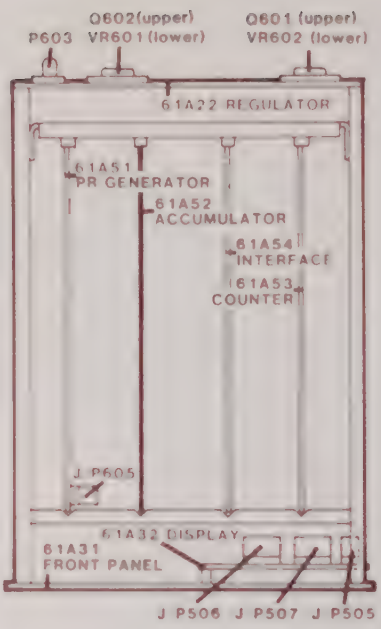



ERROR REGEN
REGEN ERROR GATE
REGEN CLOCK GATE
BIT OVERFL
U84
U85
U82
U81
UC2
R203
100
R512
470
R513
470
C202
47p
R239
2k
R238
1.2k
R514
470
R517
470
R508
470
R511
470
R237
1k
R240
2k
R528
470
R241
2k
R509
470
-5.2V
+5V


61A53 COUNTER
REGEN ERROR
J203
P203
P306
REGEN CLOCK
J204
P204
P304
ERROR OUT AMPLIFIER
+5V
R206 18
C501 .01
R208 150
C201 47p
R205 22
Q202 5771
Q201 2748
J202
P202
ERROR
61A31 FRONT PANEL
ERROR OUT
J506
R210 240
R527 470
C203 .01
R204 270
-5.2V
CLOCK OUT AMPLIFIER
U81
R248 18
C210 .01
R246 150
C212 47p
R245 22
Q204 5771
Q203 2748
J205
P205
CLOCK
J501
CLOCK OUT
R249 240
R244 470
C211 .01
R243 270
C209 1000p
R510 470
RESET
100 BITS
2500 BITS
ERROR'
10BITS'


61A52 ACCUMULATOR
J207
J206
J205
J204
J202
J203
J201
Q204
Q203
Q202
Q201
UB1
UB2
UB3
UB4
UB5
UC2
UC3
UC4
UC5
UD1
UD2
UD3
UD4
UD5
UE1
UE2
UE3
UE4
UE5
UF1
UF2
UF3
UF4
UF5
C209
C230
C505
C502
C504
C509
C510
C508
C511
C512
C515
C517
C518
C519
C522
C526
C527
C529
C530
C523
C524
C525
C291
C210
R231
R240
R275
R226
R228
R229
R220
D201


ACCUMULATOR
R506
R241
R509
R237
R235
R243
R507
R508
R233
R524
R501
R244
R526
R525
R503
R504
R527
R505
R515
R518
R292
R291
R204
R514
R520



IC SIDE

NON-IC SIDE

PARTS VALUES

Unless noted otherwise

C in μf

L in μH

R in Ω

• special, see parts list

For full type numbers of ICs and transistors — parts list

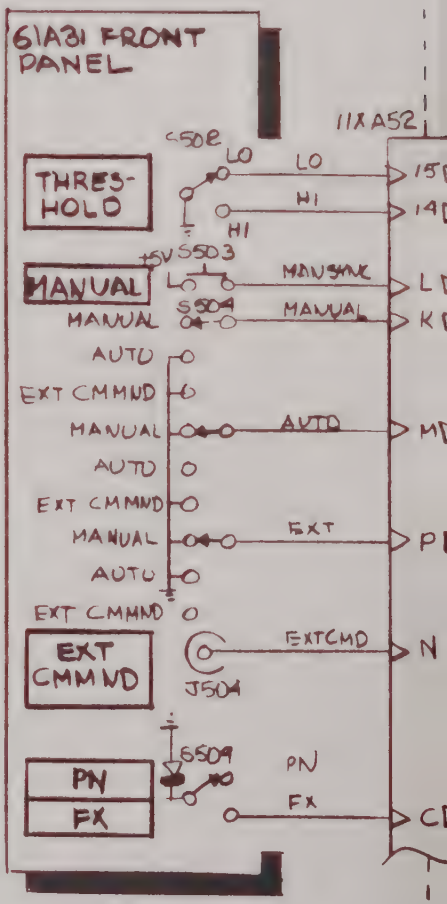
REFERENCE DESIGNATIONS

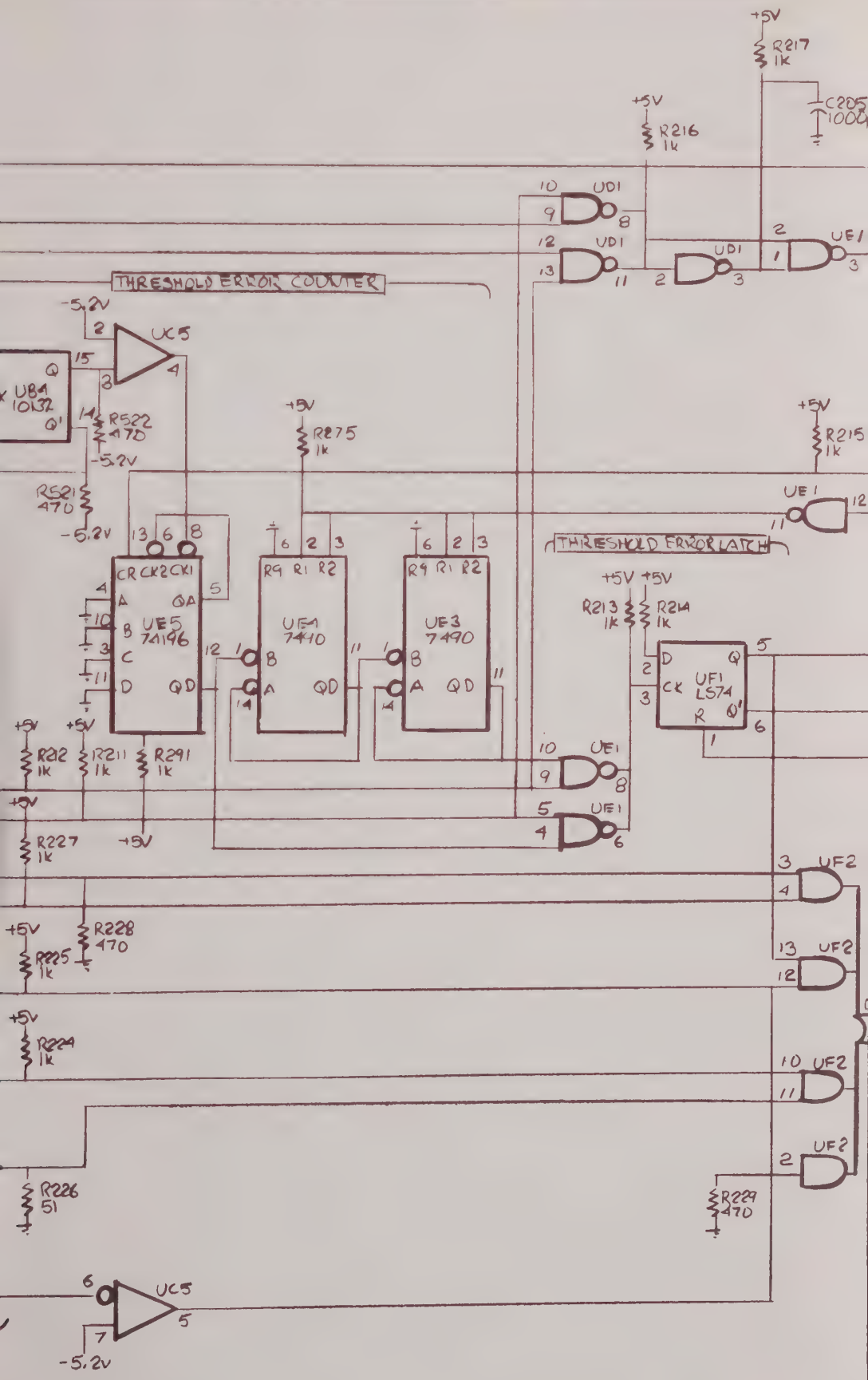
Full reference designations include assembly prefix

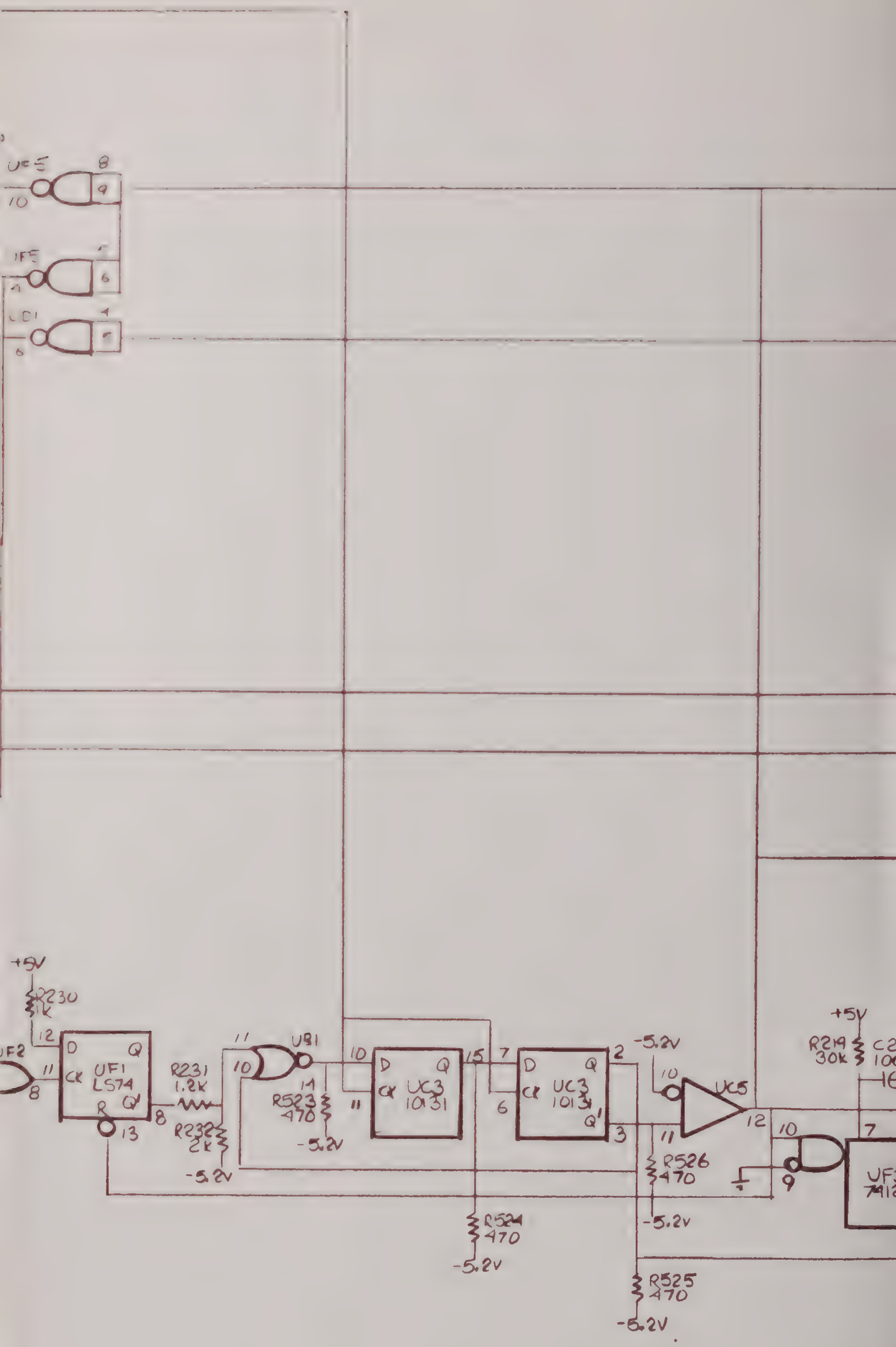
SIGNAL ORIGIN

· input

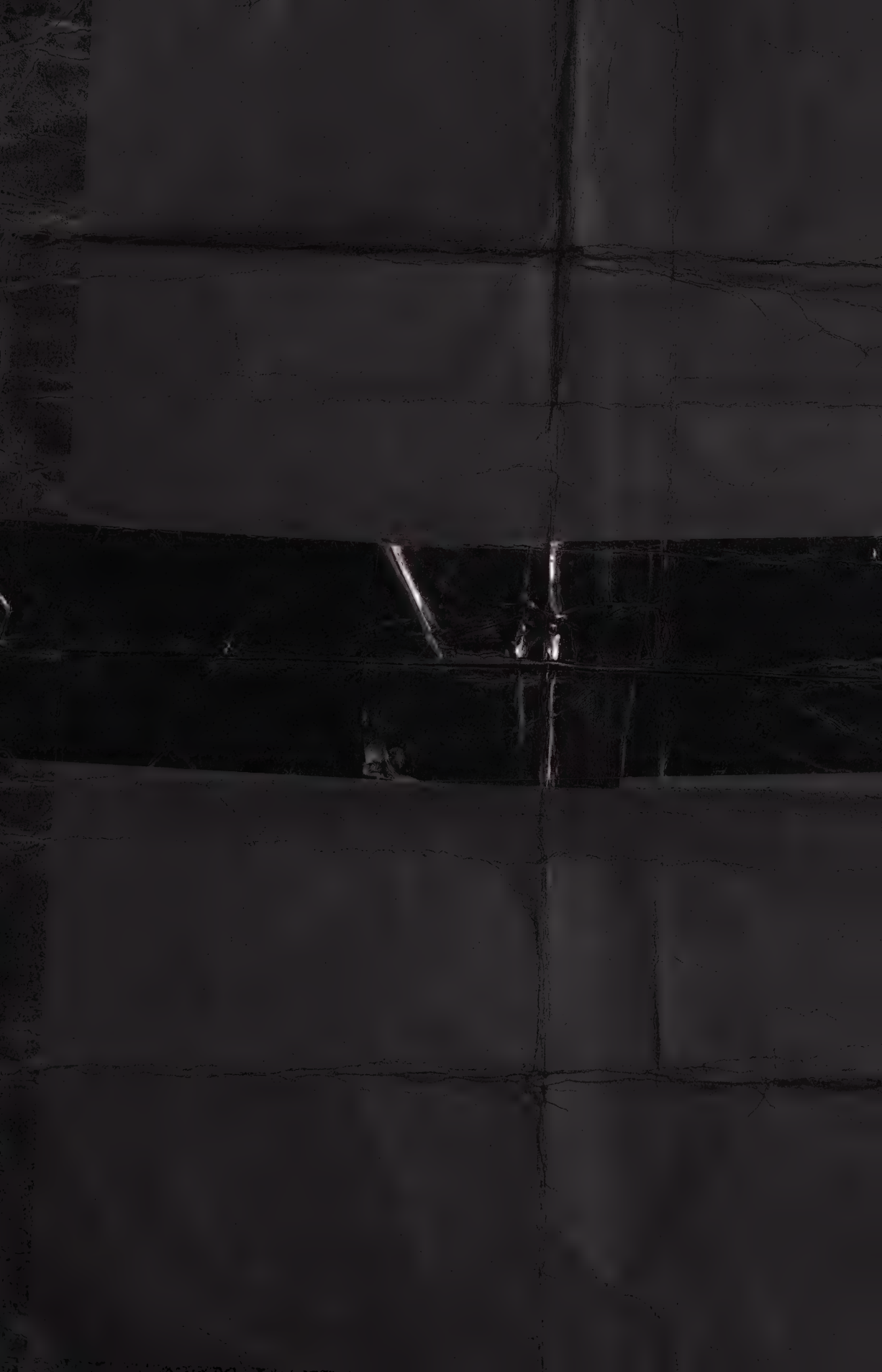
· output

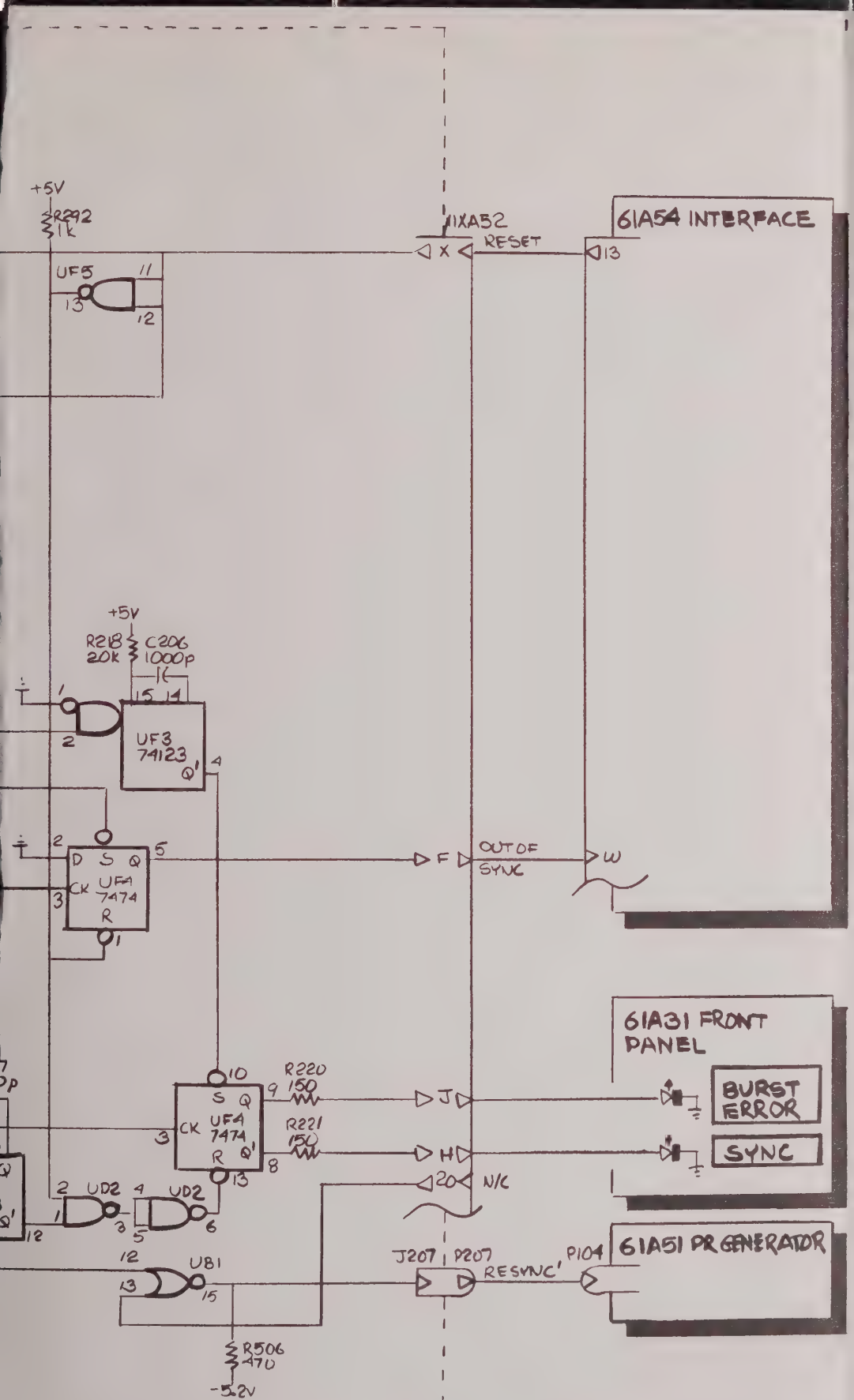



THRESHOLD ERROR COUNTER
THRESHOLD ERROR LATCH
UC5
UB4 10132
UE5 74196
UE4 7490
UE3 7490
UF1 LS74
UD1
UE1
UF2
R217 1k
R216 1k
C205 1000
R215 1k
R275 1k
R213 1k
R214 1k
R212 1k
R211 1k
R291 1k
R227 1k
R225 1k
R224 1k
R228 470
R226 51
R229 470
R522 470
R521 470
+5V
-5.2V



+5V
R230
1k
12
11
8
D
Q
CK
UF1
LS74
R
Q'
13
R231
1.2K
R232
2K
-5.2V
UB1
10
D
Q
CK
UC3
10131
R523
470
15
7
6
UC3
10131
2
3
R524
470
-5.2V
UC5
R526
470
R525
470
R219
30K
+5V
9

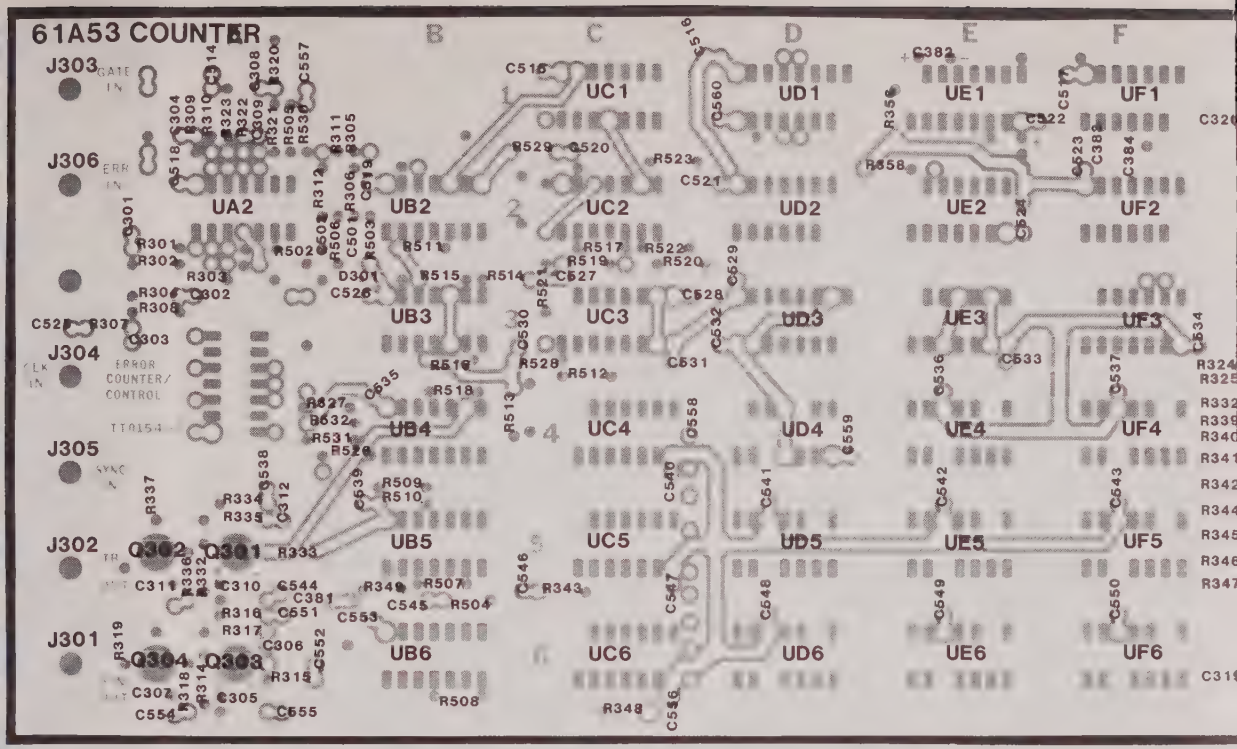


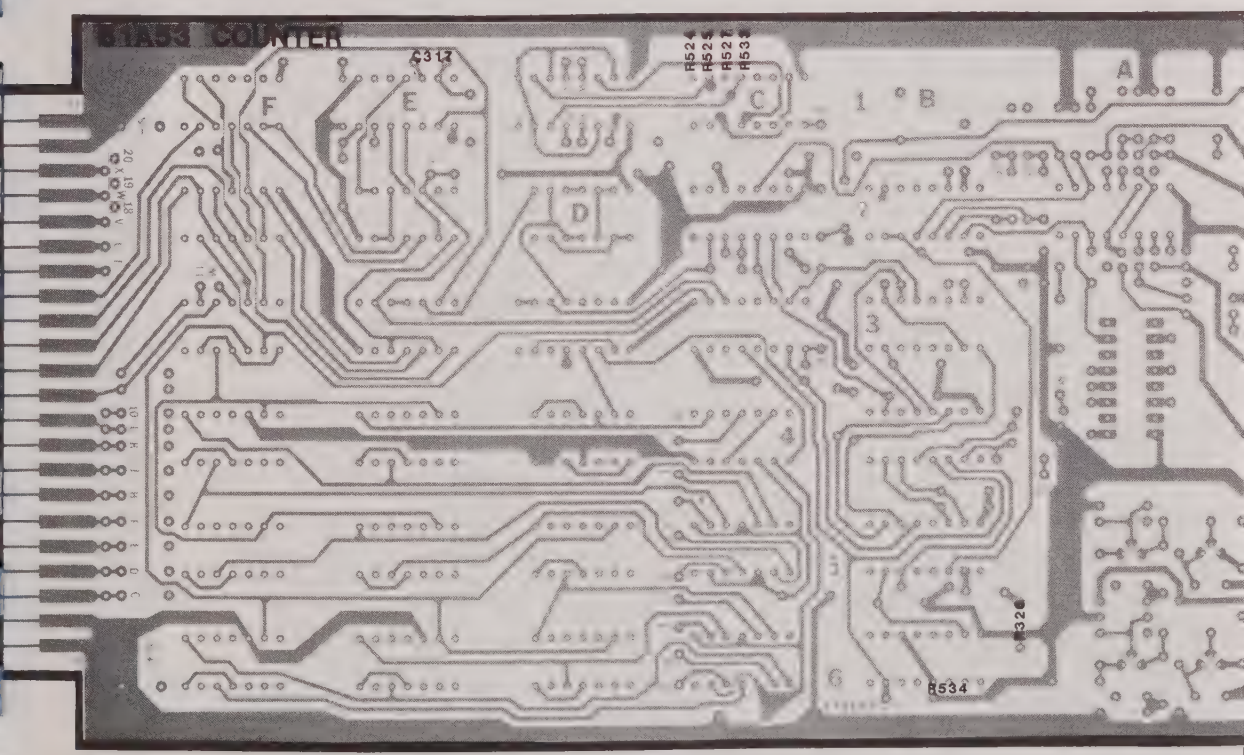


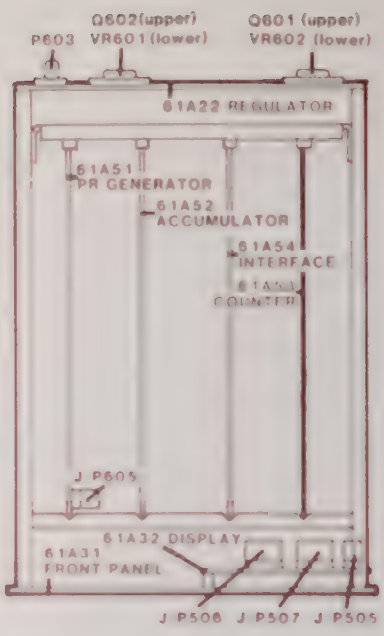
TDJ-53616
REV 5

Form 0155-1081C
TAU-TRON
M8-1A

2 of 2 **61A52**
ACCUMULATOR


61A53 COUNTER
J303
J306
J304
J305
J302
J301
UA2
UB2
UB3
UB4
UB5
UB6
UC1
UC2
UC3
UC4
UC5
UC6
UD1
UD2
UD3
UD4
UD5
UD6
UE1
UE2
UE3
UE4
UE5
UE6
UF1
UF2
UF3
UF4
UF5
UF6
Q302
Q301
Q304
Q303


61A53 COUNTER



IC SIDE

NON-IC SIDE

PARTS VALUES

Unless stated otherwise:

C in μF

L in μH

R in Ω

* special, see parts list

For full type numbers of IC's and transistors see parts list

REFERENCE DESIGNATIONS

Full reference designations include assembly prefix

SIGNAL ORIGIN

- input
- output

61A54 INTERF

61A52 ACCUMU

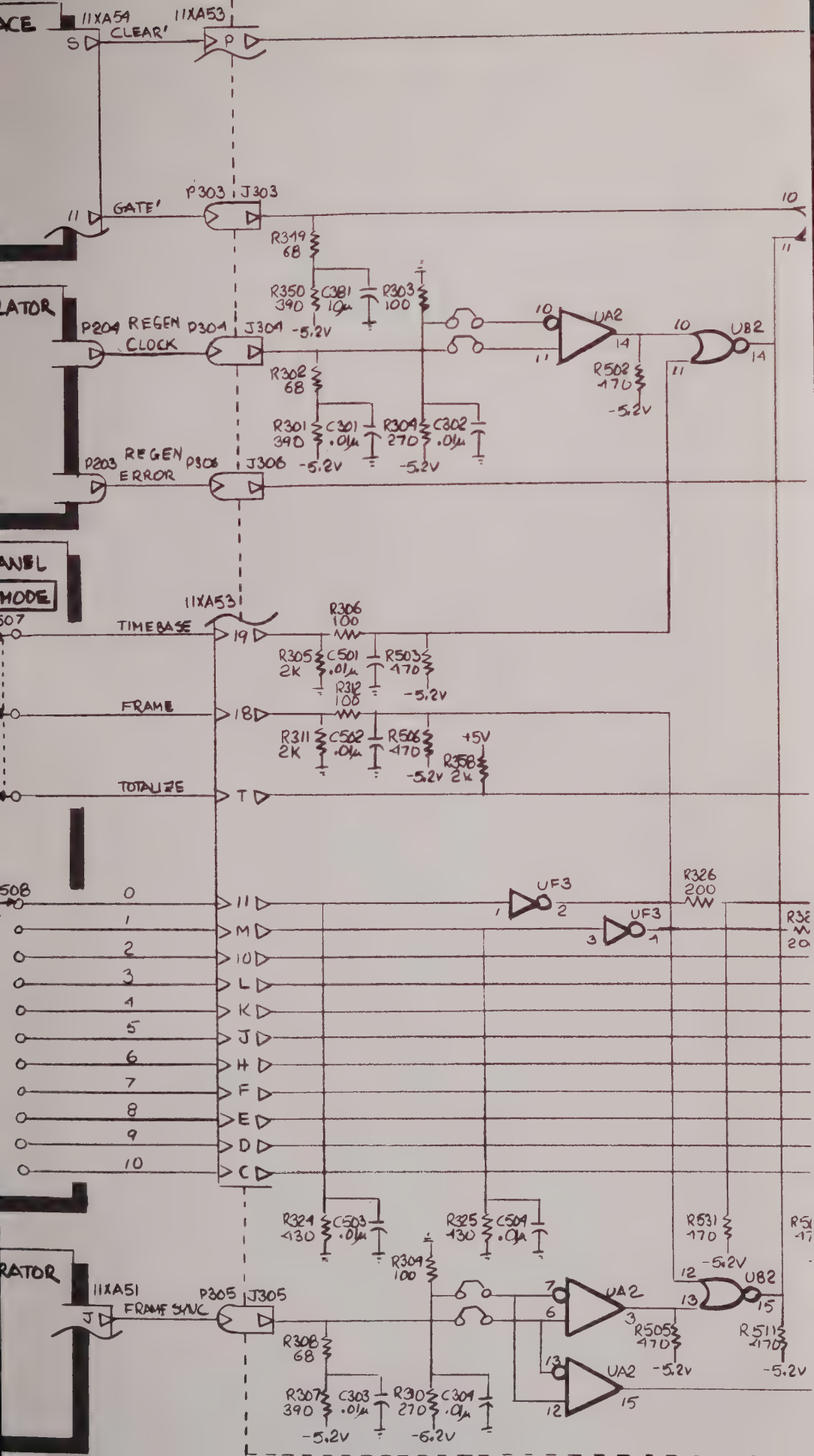
61A31 FRONT

MEASUREMENT

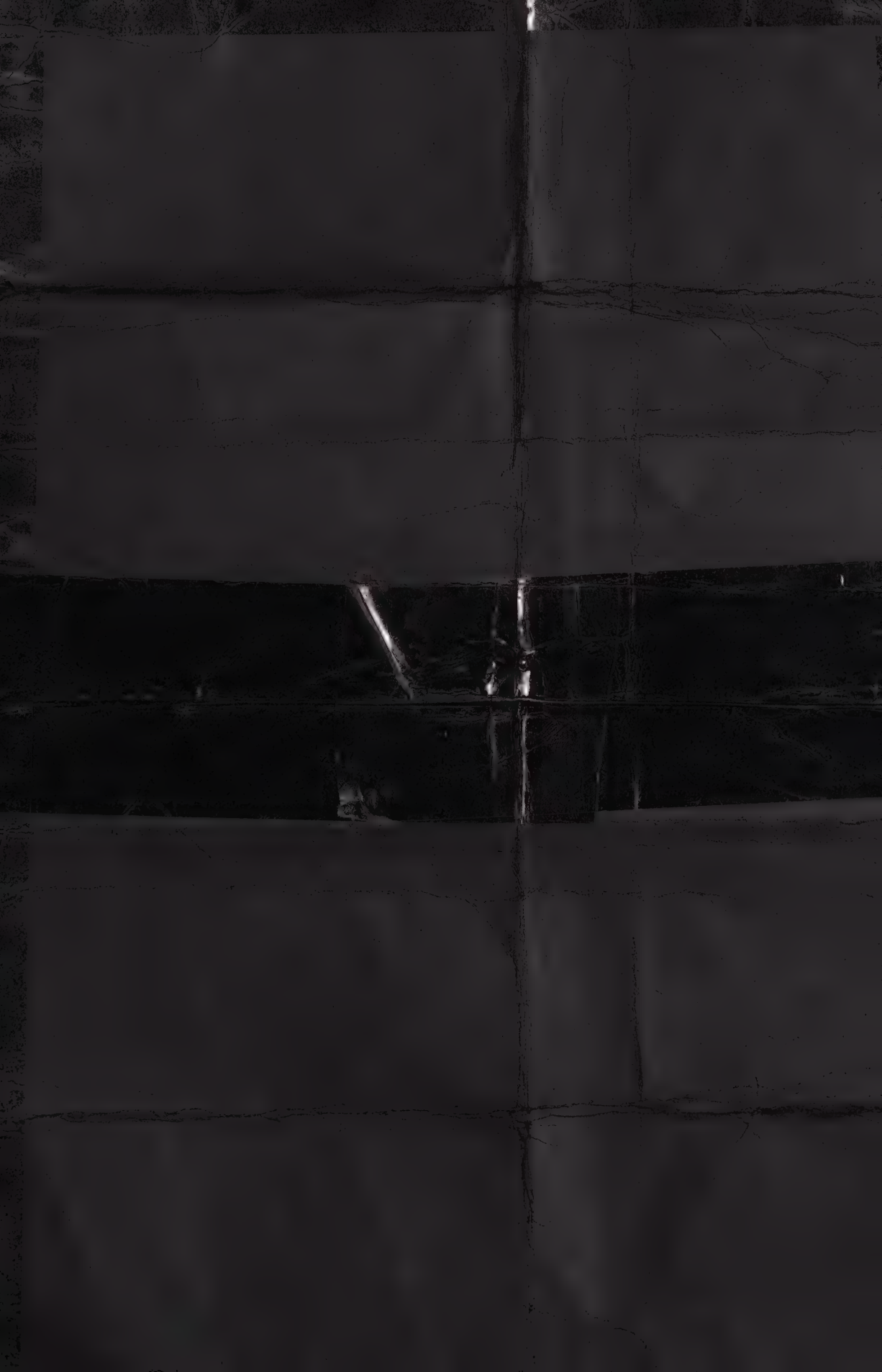
TIME RATE
FRAME
TOTALIZE
TIME RATE
FRAME
TOTALIZE
TIME RATE
FRAME
TOTALIZE

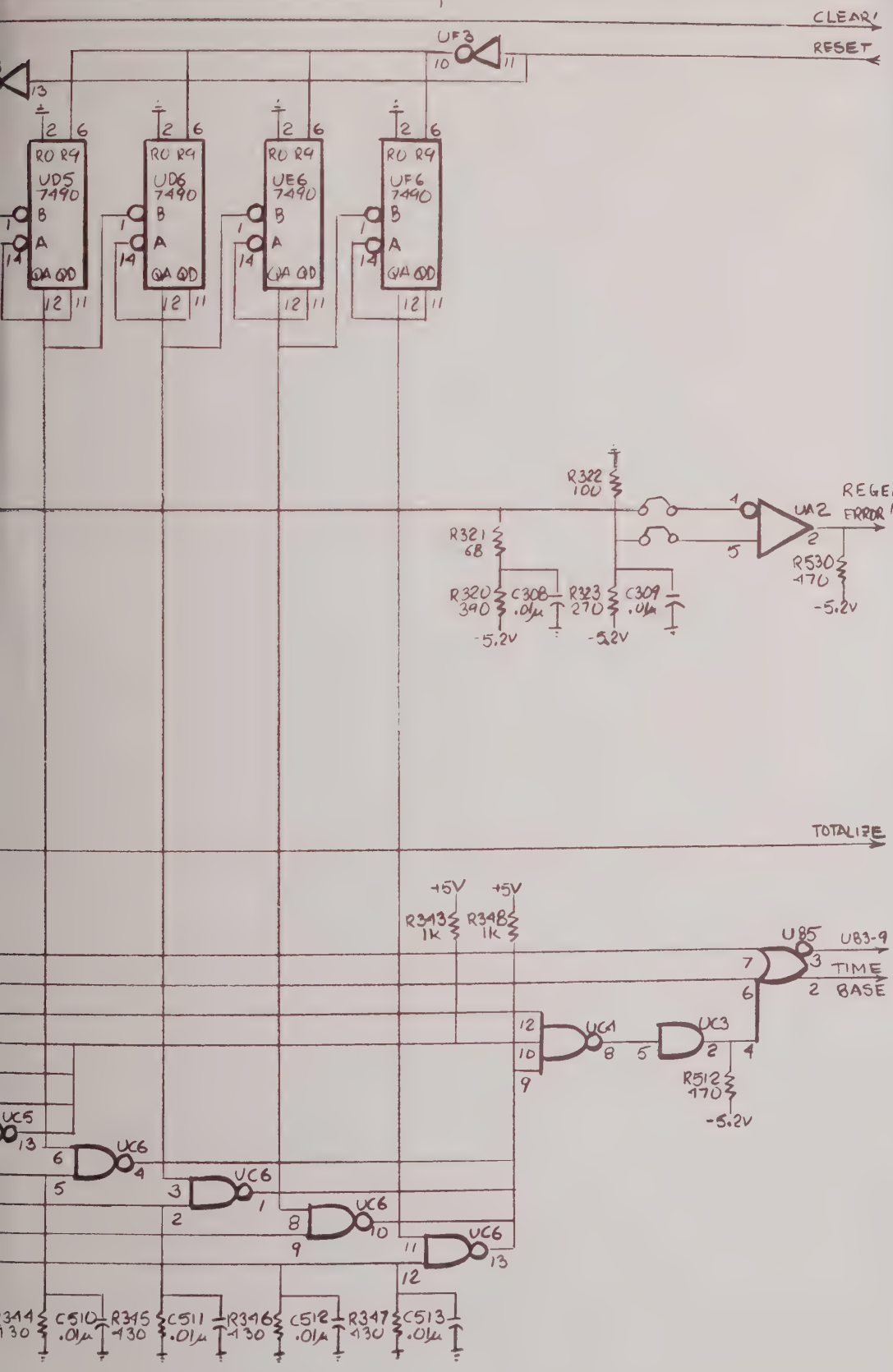
TIME BASE
0
1
2
3
4
5
6
7
8
9
10

61A51 PR GENE


11XA54
CLEAR'
11XA53
S
P
P303
J303
GATE'
11
10
R319
68
R350
390
C381
10μ
R303
100
P204
REGEN
CLOCK
P304
J304
-5.2V
UA2
UB2
R302
68
R508
470
R301
390
C301
.01μ
R304
270
C302
.01μ
P203
REGEN
ERROR
P305
J306
11XA53
TIMEBASE
19
R306
100
R305
2K
C501
.01μ
R503
470
R312
100
FRAME
18
R311
2K
C502
.01μ
R506
470
+5V
R358
2K
TOTALIZE
T
0
1
2
3
4
5
6
7
8
9
10
11
M
10
L
K
J
H
F
E
D
C
UF3
R326
200
R321
430
C503
.01μ
R325
430
C504
.01μ
R309
100
R531
470
R308
68
R307
390
C303
.01μ
R305
270
C304
.01μ
-6.2V
11XA51
P305
J305
FRAME SYNC
R505
470
R511
470

RATE COUNTER
+5V
UB5
UB6
UD3
UE4
UF4
UF5
UE5
UB4
UC4
UC5
R504
470
R501
470
-5.2V
R532
470
R508
470
R338
430
C505
R339
430
C506
.01μ
R340
430
C507
.01μ
R341
430
C508
.01μ
R342
430
C509
.01μ
R509
470
R510
470

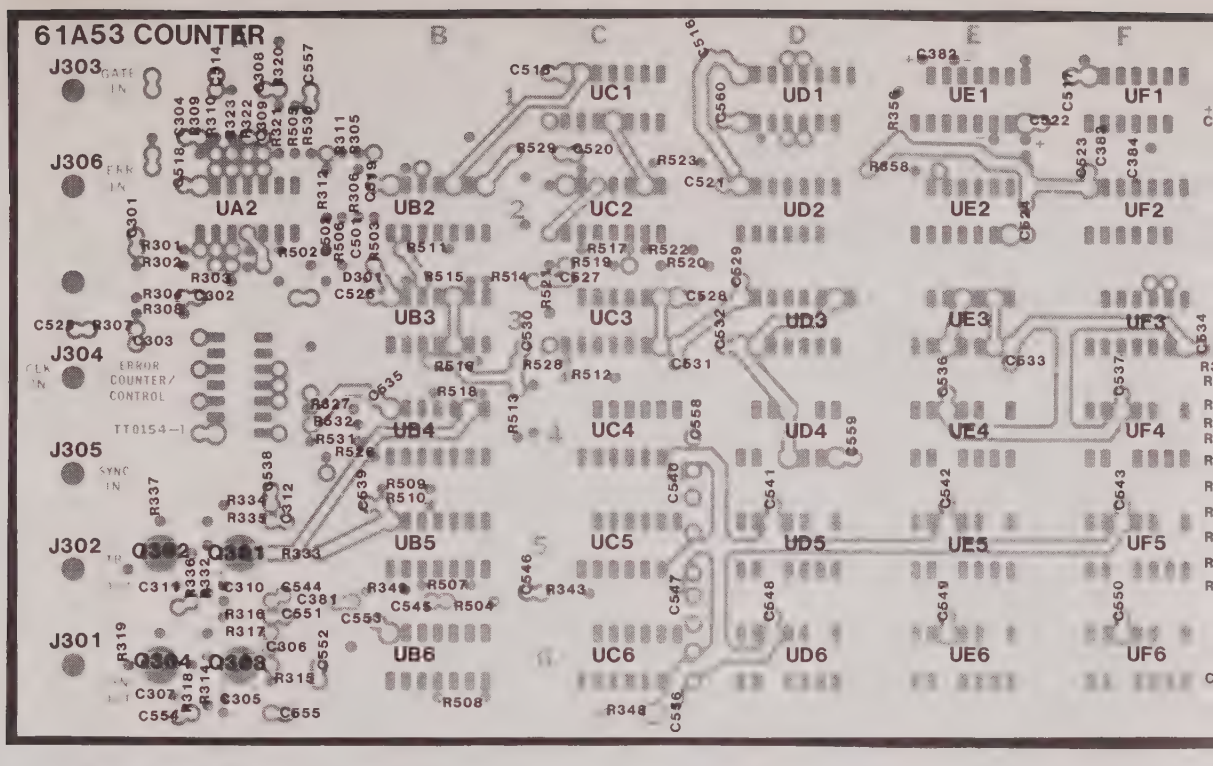


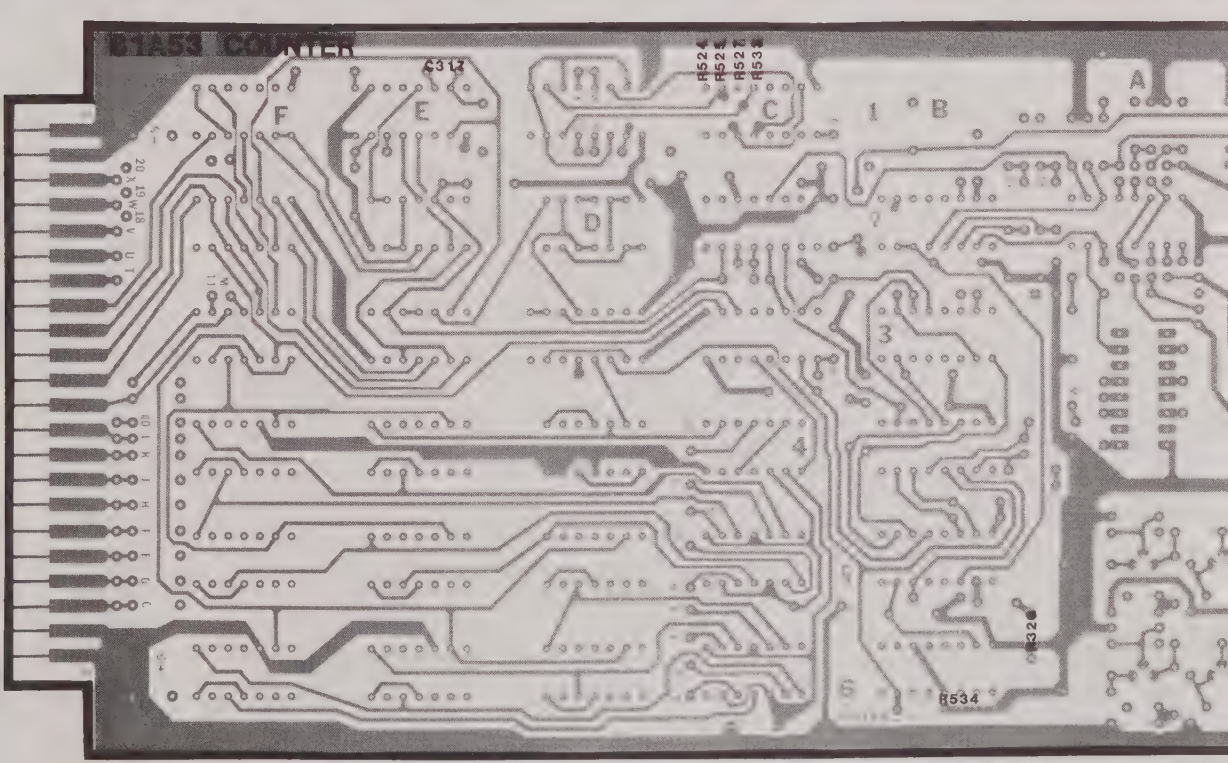


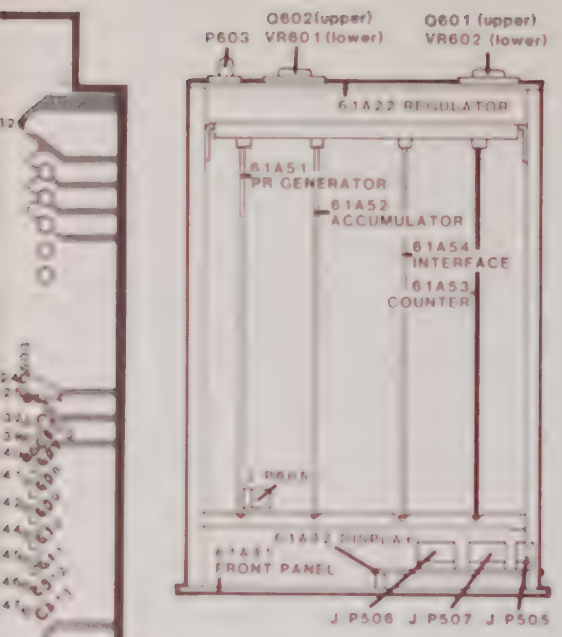
TDJ-53893
REV 3

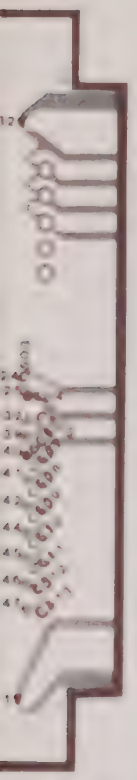
Form 155-1081C
TAU-TRON
MB-1A

SYNC 1 of 2 **61A53** COUNTER


61A53 COUNTER
J303
GATE IN
J306
ERR IN
J304
CLK IN
ERROR COUNTER/ CONTROL
TT0154-1
J305
SYNC IN
J302
J301
UA2
UB2
UC1
UD1
UE1
UF1
UB3
UC2
UD2
UE2
UF2
UB4
UC3
UD3
UE3
UF3
UB5
UC4
UD4
UE4
UF4
UB6
UC5
UD5
UE5
UF5
UC6
UD6
UE6
UF6


61A53 COUNTER





IC SIDE

NON-IC SIDE

PARTS VALUES

Unless noted otherwise

C in μf

L in μH

R in Ω

* special, see parts list

For full type numbers of ICs and transistors see parts list

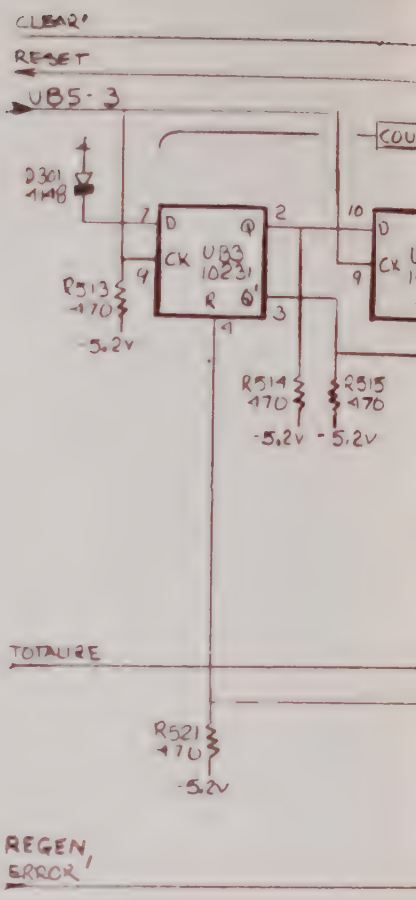
REFERENCE DESIGNATIONS

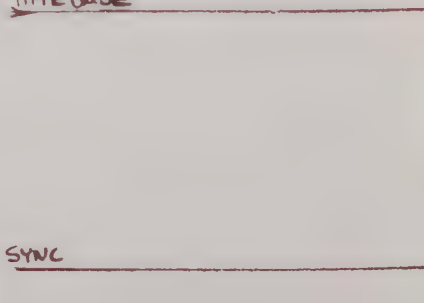
Full reference designations include assembly prefix

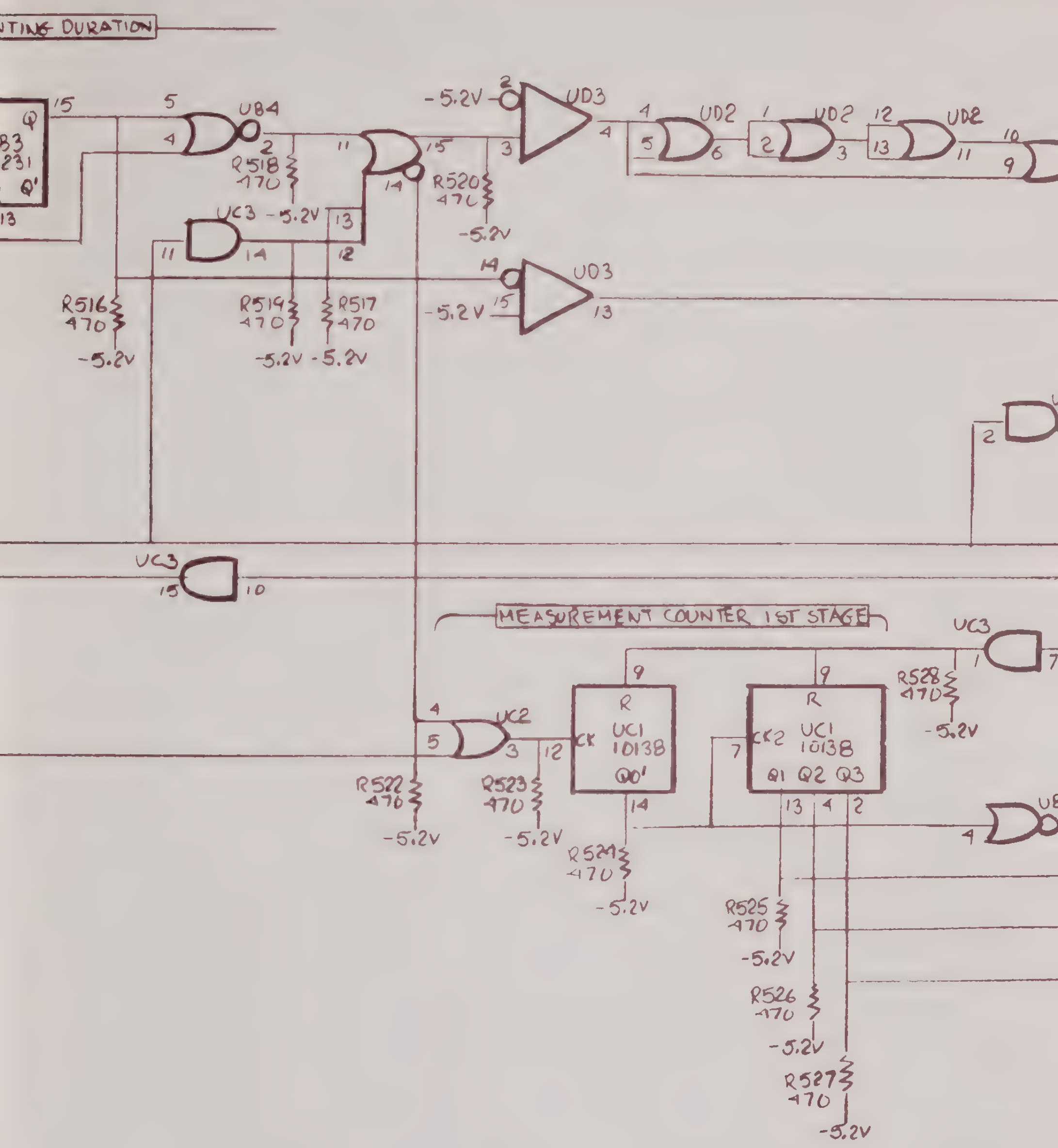
SIGNAL ORIGIN

>— input

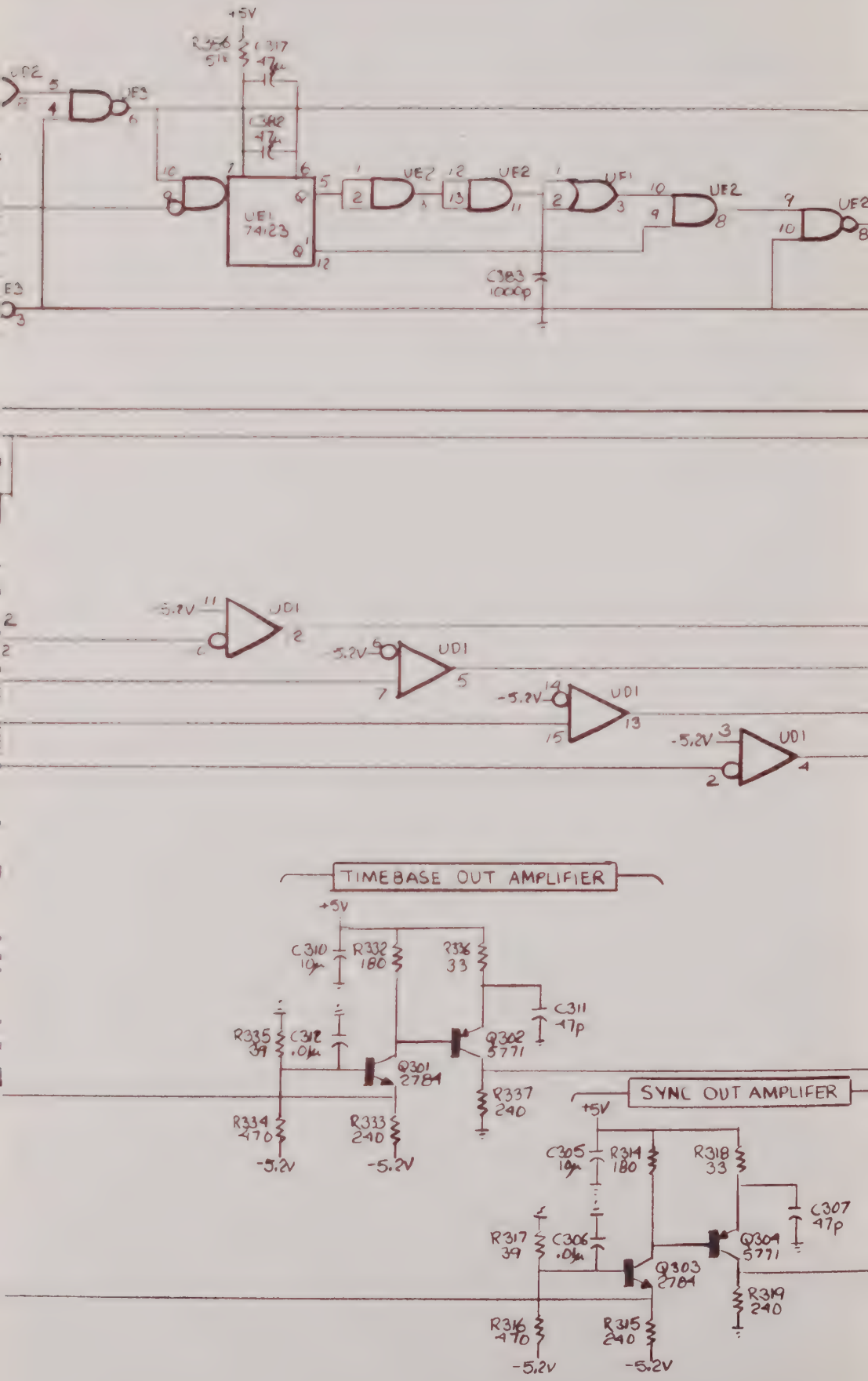
—• output

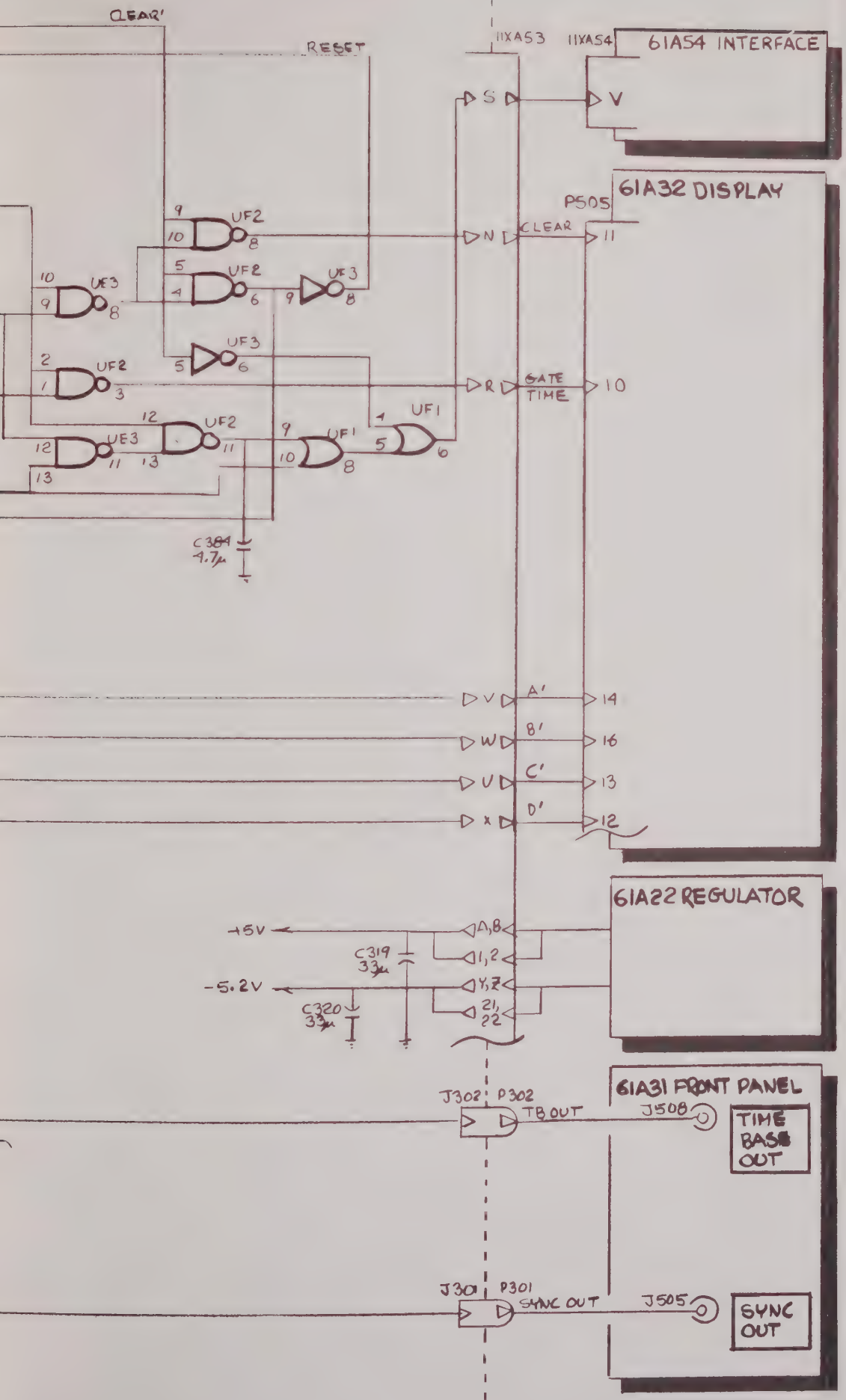




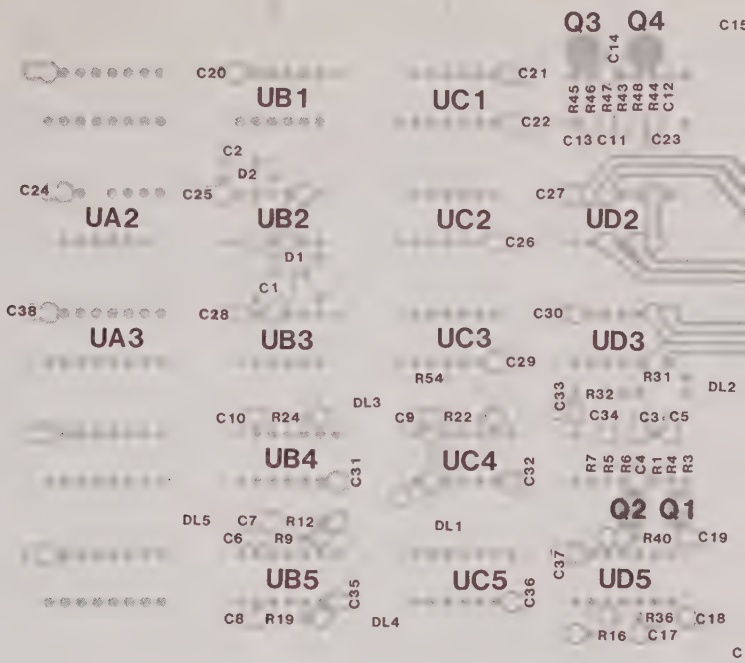


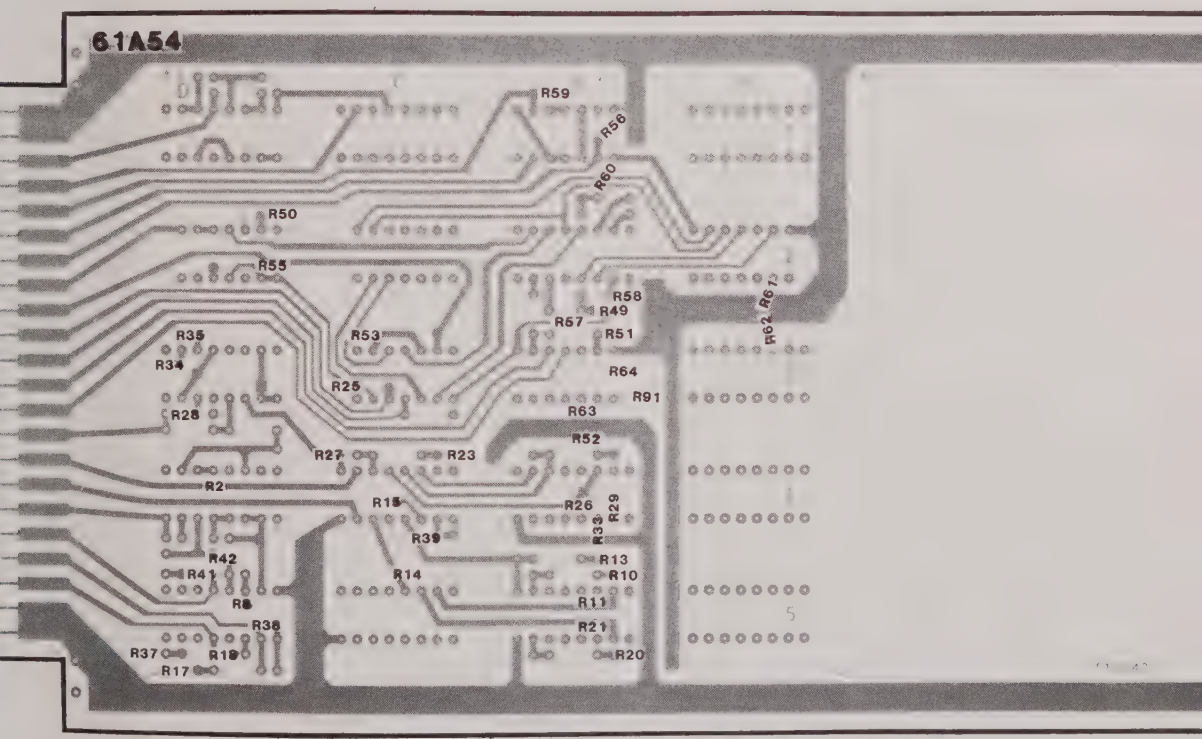
NTING DURATION
MEASUREMENT COUNTER 1ST STAGE
UB4
UC3
UD3
UD2
UC2
UC1 10138
R516 470
R517 470
R518 470
R519 470
R520 470
R522 470
R523 470
R524 470
R525 470
R526 470
R527 470
R528 470
-5.2V

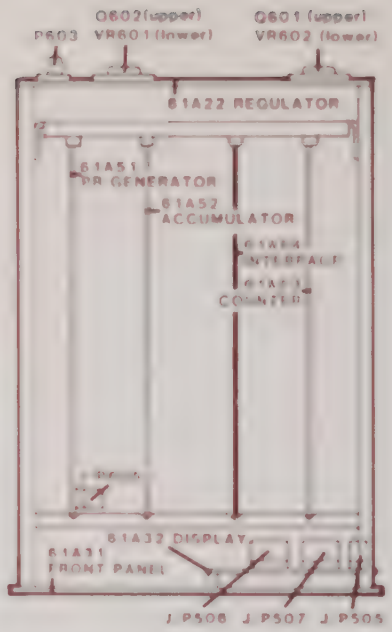

+5V
R356 51k
C317 47µ
C382 47µ
UE1 74123
UE2
UE3
C383 1000p
-5.2V
UD1
TIMEBASE OUT AMPLIFIER
C310 10µ
R332 180
R336 33
C311 47p
R335 39
C312 .01µ
Q301 2784
Q302 5771
R337 240
R334 470
R333 240
SYNC OUT AMPLIFER
C305 10µ
R314 180
R318 33
C307 47p
R317 39
C306 .01µ
Q303 2784
Q304 5771
R319 240
R316 470
R315 240


CLEAR'
RESET
11XA53
11XA54
61A54 INTERFACE
S
V
61A32 DISPLAY
P505
UF2
UE3
UF3
UF1
N
CLEAR
11
R
GATE TIME
10
C384 4.7μ
V
A'
14
W
B'
16
U
C'
13
X
D'
12
61A22 REGULATOR
+15V
-5.2V
C319 33μ
C320 33μ
A,B
1,2
Y,Z
21,22
61A31 FRONT PANEL
J302
P302
TB OUT
J508
TIME BASE OUT
J301
P301
SYNC OUT
J505
SYNC OUT
TDJ-53893 REV3
Form 155-1081C TAU-TRON MB-1A
2 of 2 61A53 COUNTER
61-621

61A54


Q3 Q4
C15
C20
C21
UB1
UC1
C14
R45 R46 R47 R43 R48 R44 C12
C22
C13 C11 C23
C2
D2
C24
C25
C27
UA2
UB2
UC2
UD2
C26
D1
C1
C38
C28
C30
UA3
UB3
UC3
UD3
C29
R54
R31
DL2
DL3
C33
R32
C10 R24
C9 R22
C34 C3 C5
UB4
UC4
C31
C32
R7 R5 R6 C4 R1 R4 R3
Q2 Q1
DL5 C7 R12
DL1
C6 R9
R40 C19
C37
UB5
UC5
UD5
C35
C36
C8 R19
DL4
R36 C18
R16 C17
C


61A54
R59
R56
R60
R50
R55
R58
R49
R57
R51
R62 R61
R35
R34
R53
R64
R25
R91
R63
R28
R52
R27
R23
R2
R15
R26
R29
R33
R39
R42
R13
R41
R14
R10
R8
R11
R38
R21
R37
R18
R20
R17



IC SIDE

NON-IC SIDE

PARTS VALUES

Unless noted otherwise:

C in μF

L in μH

R in Ω

Special, see parts list

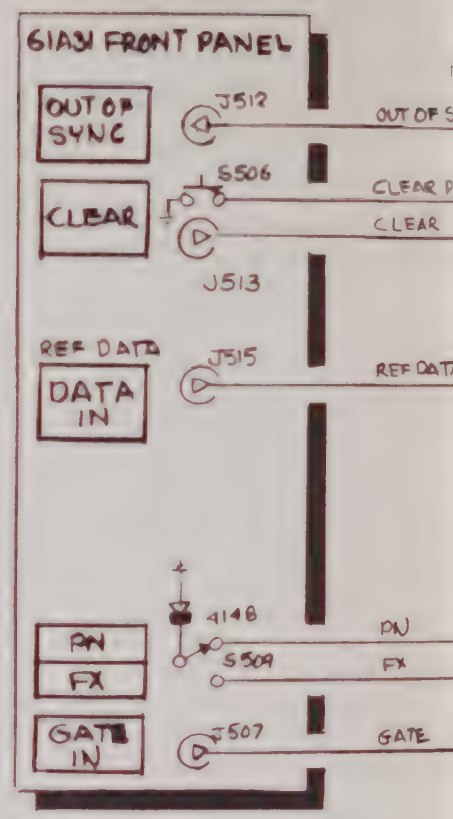
For full type numbers of ICs and transistors see parts list

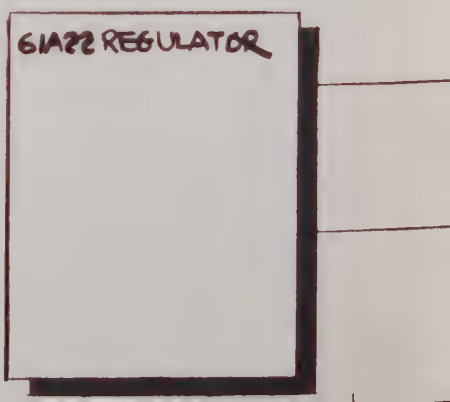
REFERENCE DESIGNATIONS

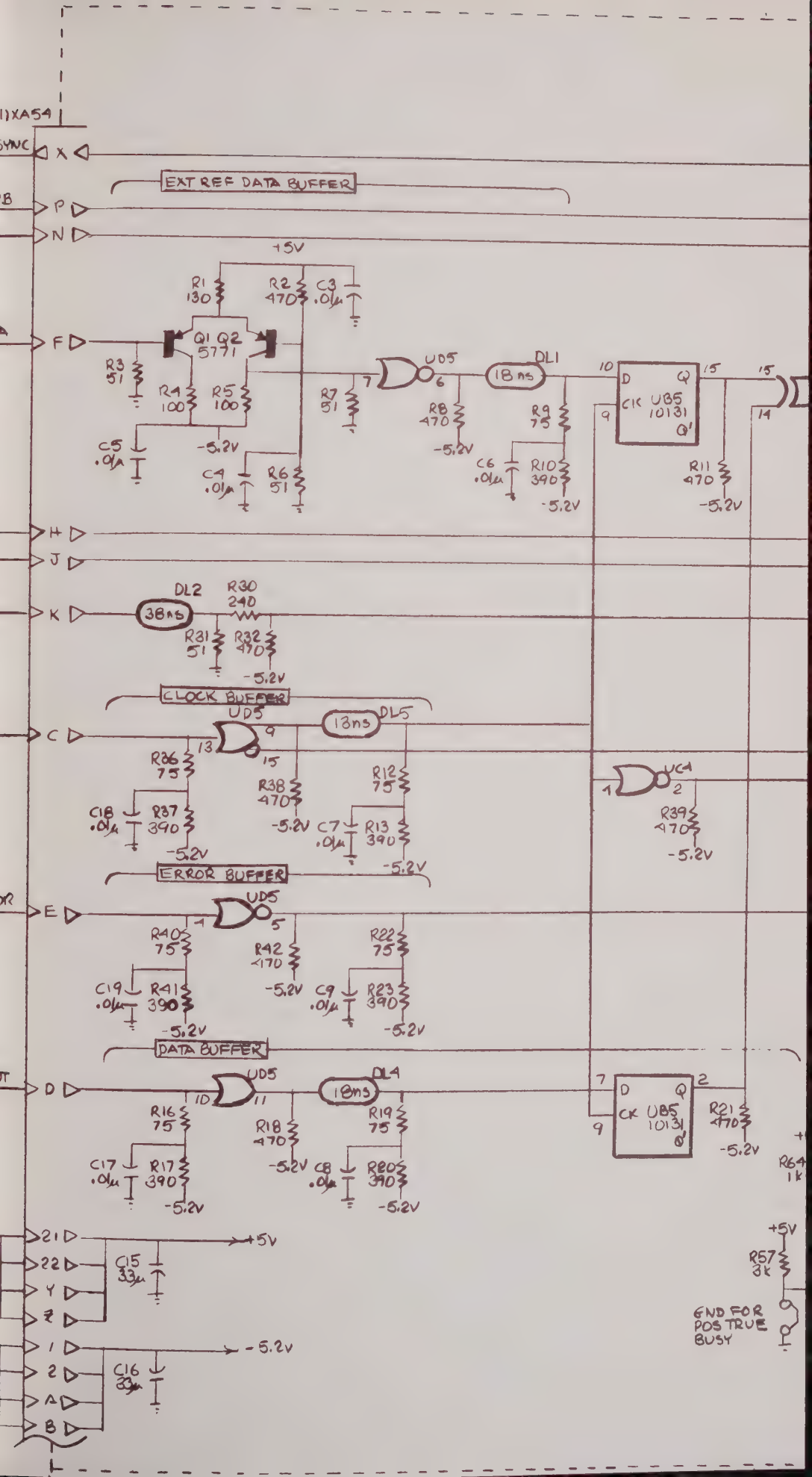
Full reference designations include assembly prefix

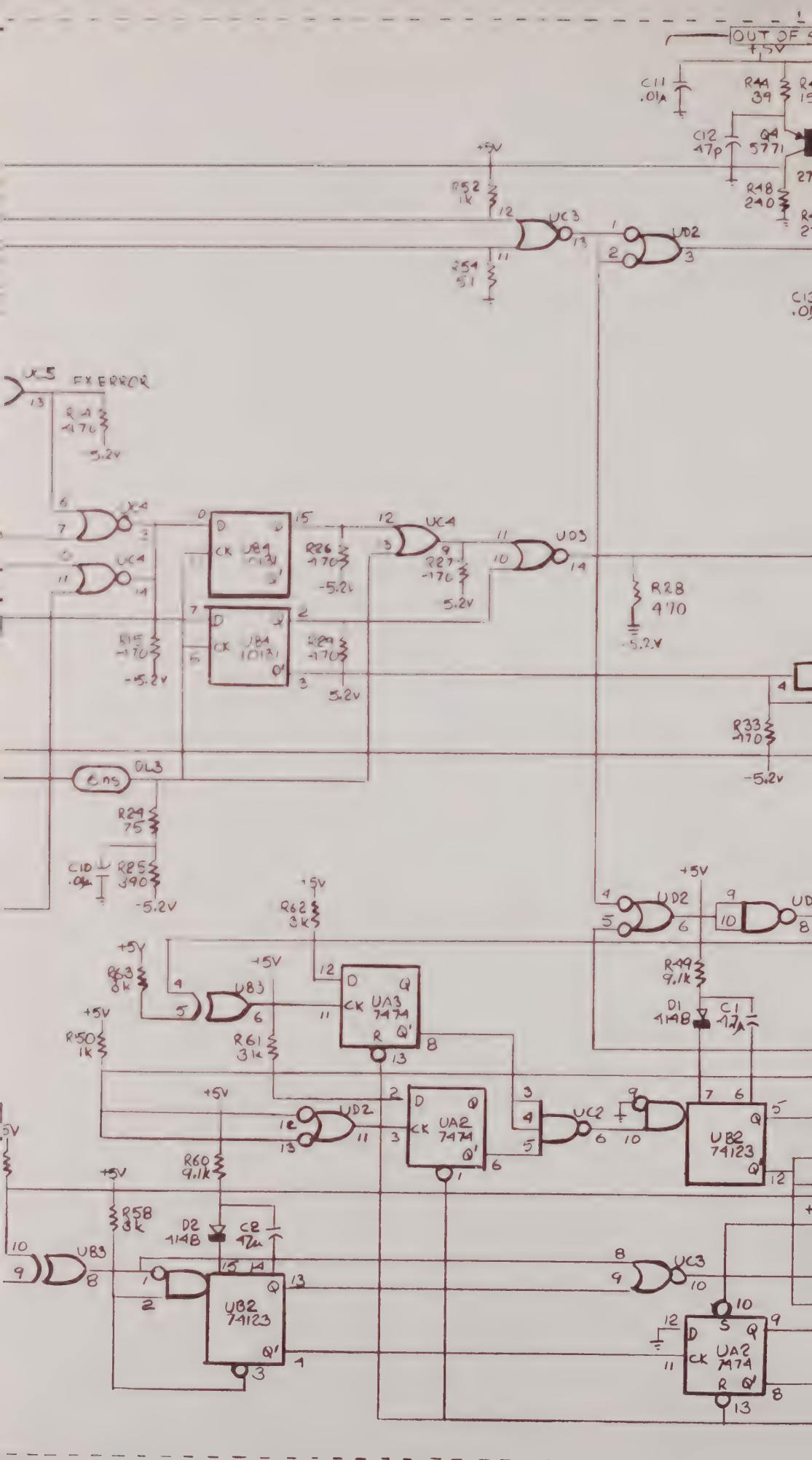
SIGNAL ORIGIN

- input
- output

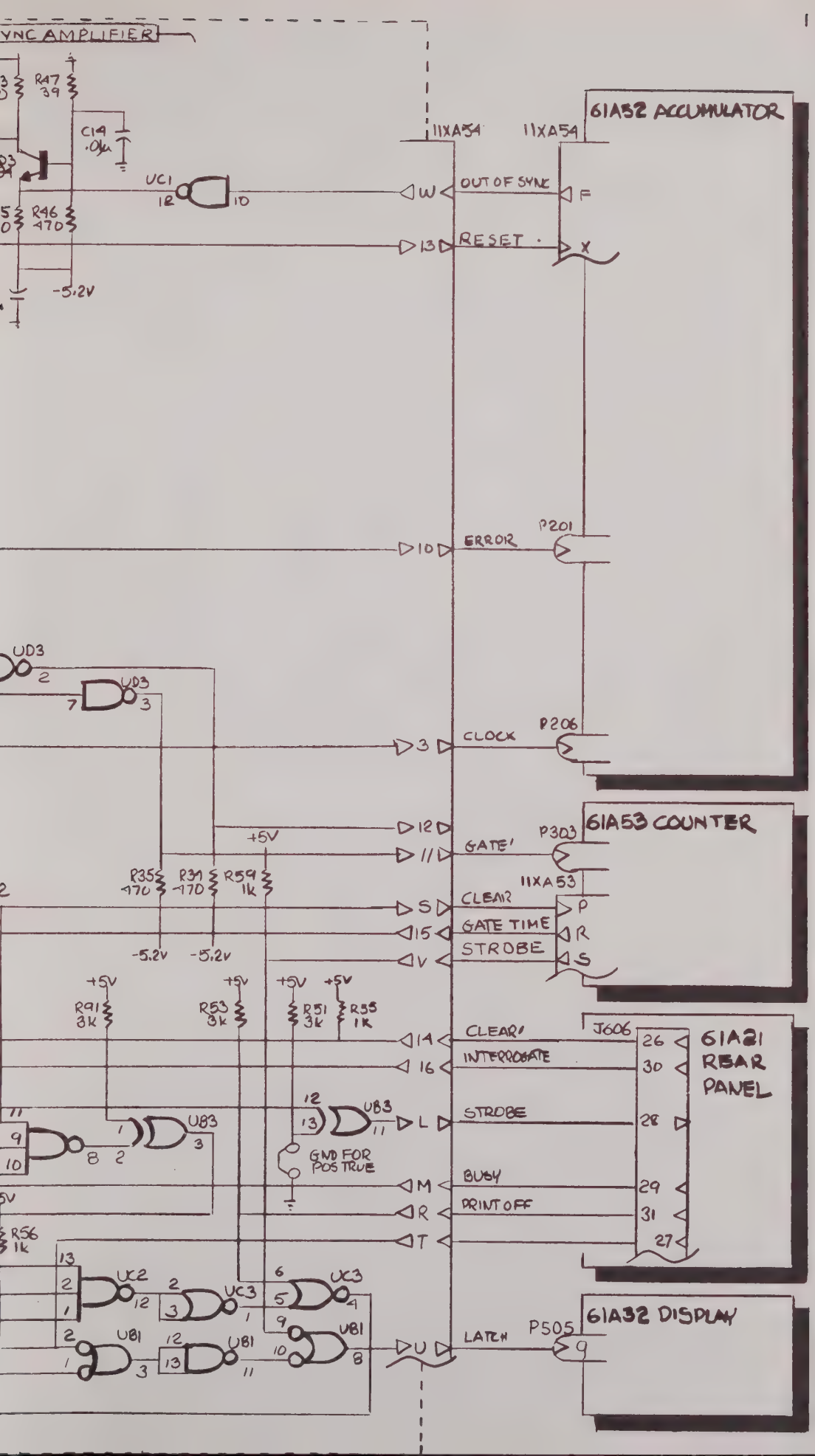





EXT REF DATA BUFFER
+5V
R1 130
R2 470
C3 .01µ
Q1 Q2 5771
R3 51
R4 100
R5 100
R7 51
UD5
DL1
18ns
R8 470
R9 75
R10 390
C6 .01µ
C5 .01µ
C4 .01µ
R6 51
-5.2V
UB5 10131
R11 470
DL2
38ns
R30 240
R31 51
R32 470
CLOCK BUFFER
13ns
DL5
R36 75
R38 470
R12 75
C18 .01µ
R37 390
C7 .01µ
R13 390
UC4
R39 470
ERROR BUFFER
R40 75
R42 470
R22 75
C19 .01µ
R41 390
C9 .01µ
R23 390
DATA BUFFER
DL4
18ns
R16 75
R18 470
R19 75
C17 .01µ
R17 390
C8 .01µ
R20 390
R21 470
R64 1k
C15 33µ
C16 33µ
R57 3k
END FOR POS TRUE BUSY
X
P
N
F
H
J
K
C
E
D
21
22
Y
Z
1
2
A
B



OUT OF
+5V
C11 .01A
R44 39
C12 47p
Q4 5771
R48 240
R52 1k
UC3
UD2
R54 51
UC5
EXERROR
R4 470
-5.2V
UC4
UB4 10131
R26 470
R27 470
UD3
R28 470
R15 470
R29 470
R33 470
DL3
6ns
R24 75
C10 .01µ
R25 390
R62 3k
R63 3k
UB3
UA3 7474
R50 1k
R61 3k
R49 9.1k
D1 4148
C1 47µ
UA2 7474
UC2
UB2 74123
R60 9.1k
R58 3k
D2 4148
C2 47µ
UC3
UA2 7474



TDJ-53553 REV4

Form 155-1081C TAU-TRON MB-1A

1 of 1 **61A54** INTERFACE

Changes

61.700 **CONTENTS**

Where not contained in the body of the manual, information on options, variations, and modifications is contained in this section.

ADDENDEM

True Manufacturers Master Parts List

Tau-Tron No.	True Manfacturer Name	True Manufacturer No.
0012-2100 thru 0012-5510	Allen Bradley	Type BB
0022-1300 thru 0022-3300	Allen Bradley	Type CB
0032-4200	Allen Bradley	Type EB
0282-0100	Dale	HLM-15
0333-4200A	Allen Bradley	A2B202
0333-4500B	Allen Bradley	WA21L040S502UC
0333-4500E	Bournes	3540S-1-502
1013-8222	Vitramon	VK23BW220K
1013-8247	Vitramon	VK23BW470K
1013-8310	Vitramon	VK23BX101K
1014-4610	Vitramon	VK33BX104M
1014-8410	Vitramon	UK23BX102K
1014-8447	Vitramon	VK23BW472K
1024-1322	Sprague	150D227X9010
1024-5110	Sprague	150D105X9035A2
1024-5147	Sprague	150D475X9035B2
1024-5210	Sprague	150D106X9035R2
1034-4482	Sprague	36D822G025AC2A
1034-0452	Sprague	36D522G050AD2A
1059-8253	Erie	538-011D, 4-35PF
1064-0847	Corning	MMS-006-476R-20
1064-1233	Corning	MMS-010-336R-20
1064-3747	Corning	MMS-020-475R-20
1064-4210	Corning	MMS-025-106R-20
1084-4710	Vitramon	VJ0805X103MH
2103-9902	Motorola	MDA-990-2
2112-4148	Fairchild	IN4148
2112-4710	Fairchild	IN4148
2143-1403	Monsanto	MV1403
2274-MV50	Motorola	MV50
2274-5053	Motorola	MV5023
3180-2955	Motorola	MJ2955
3180-5301	Motorola	2N5301
3224-5771	Transitron	2N5771
3302-2784	Transitron	2N2784
4012-1648	Motorola	MC1648P
4012-1660	Motorola	MC1660P
4012-1662	Motorola	MC1662P
4012-1670	Motorola	MC1670P
4012-1672	Motorola	MC1672P
4012-7400	Texas Instruments	SN7400
4012-7401	Texas Instruments	SN7401
4012-7402	Texas Instruments	SN7402
4012-7404	Texas Instruments	SN7404
4012-7408	Texas Instruments	SN7408
4012-7410	Texas Instruments	SN7410
4012-7432	Texas Instruments	SN7432

Tau-Tron No.	True Manufacturer Name	True Manufacturer No.
4012-7474	Texas Instruments	SN7474
4012-7474A	Texas Instruments	SN7474A
4012-7476	Texas Instruments	SN7476
4012-7486	Texas Instruments	SN7486
4012-7490	Texas Instruments	SN7490
4012-01031	Motorola	MC01031P
4012-10101	Motorola	MC10101P
4012-10102	Motorola	MC10102P
4012-10105	Motorola	MC10105P
4012-10109	Motorola	MC10109P
4012-10115	Motorola	MC10115P
4012-10124	Motorola	MC10124P
4012-10125	Motorola	MC10125P
4012-10131	Motorola	MC10131P
4012-10138	Motorola	MC10138P
4012-10141	Motorola	MC10141P
4012-10211	Motorola	MC10211P
4012-10216	Motorola	MC10216P
4012-10231	Motorola	MC10231P
4012-74123	Texas Instruments	SN74123
4012-74196	Texas Instruments	SN74196
4012-74H00	Texas Instruments	SN74H00
4012-74H01	Texas Instruments	SN74H01
4012-74H04	Texas Instruments	SN74H04
4012-74H20	Texas Instruments	SN74H20
4012-74H52	Texas Instruments	SN74H52
4012-74LS01	Texas Instruments	SN74LS01
4012-74LS02	Texas Instruments	SN74LS02
4012-74S74	Texas Instruments	SN74LS74
4012-74S90	Texas Instruments	SN74LS190
4012-745196	Texas Instruments	SN74LS196
4200-320K5	National	LM320K-05
4200-340K5	National	LM340K-05
4201-320K5	National	LM320K-05
4513-0304	Texas Instruments	TIL304
4513-0306	Texas Instruments	TIL306
4513-0308	Texas Instruments	TIL308
5083-3312	Nytronics	WEE0.12
9000-0000	———	Not Known.
9000-0001	Corcom	5132
9000-0101	Littlefuse	31301.5
9000-0102	Littlefuse	342014A
9000-0106	Littlefuse	313003
9000-0252	Pamotor	5502
9000-0253	Pamotor	5501
9000-0254	Pamotor	5503
9000-0302	Rotron	027119
9010-6599	Teco	6599
9110-0100	H.H. Smith	3004
9110-0101	H.H. Smith	3004
9160-0000	Mallory	VR3
9200-0001	Alco	SS111
9200-0005	C&K	7101-SYCQ
9200-0009	C&K	7211-SPYZQ

Tau-Tron No.	True Manufacturers Name	True Manufacturer No.
9200-0040	Eeco	197601G
9201-0001	Alco	SS111
9201-0003	Alco	SS24
9201-0005	Alco	MSS-2450G
9203-0000	C&K	8121
9205-0001	Carling	CTA-201-PB-B-A
9300-0012	Amphenol	225-22221-101
9300-0030	Augat	516AG10D
9300-0050	Augat	8134-HC-8P2
9300-0094	Amphenol	57-305000
9300-0103	Amphenol	26-4100-24P
9300-0104	Amphenol	26-4200-245
9301-0001	Kings	KC-79-46
9301-0056	Microdot	131-0142-0001
9301-0058	Microdot	132-0114-002
9301-0060	Microdot	131-0141-0001
9303-0003	Amphenol	61097-2
9350-1001	Vero	10563
9350-1006	Vero	11797/1
9350-1007	Vero	10312
9350-1008	Vero	50592-1/-2
9705-3395	———	Not Known
thru	———	Not Known
9705-4339	———	Not Known
9800-KSS3B	Alco	KSS-3B
9802-4943	Bournes	H-494-3

Tau-Tron, Inc. 27 Industrial Ave., Chelmsford, MA 01824